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THE BIOGRAPHY OF STEPHEN HALES, D. D., F. R. S.[1]

By Percy M. Dawson, M. D.,

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Just as the name of William Harvey stands foremost in that chapter of physiology which deals with the circulation, so does the name of Stephen Hales begin the sub-chapter on hæmodynamics.

In this sub-chapter the first important conception to be grasped by the student is that of the blood pressure, and the first experiment is designed to demonstrate its existence and to estimate its amount. This experiment is familiar to us all. It consists in connecting the femoral artery of a dog to a long glass tube. Into this tube the blood mounts up and up to a height of five or six feet and then oscillates up or down with each contraction or relaxation of the heart. Such a tube, as the student already knows, is called a manometer, and he is then told that this particular form of manometer, so simple in principle and construction, is called the "Hales manometer" after its inventor, a certain Dr. Hales. Thus every student of physiology becomes acquainted with the name of Hales, but to most of us it is a name and nothing more.

Stephen Hales was born in 1677. His grandfather, Sir Robert Hales, of Beckesbourn in Kent, was made baronet by Charles II. Sir Robert's eldest son, Thomas, married Mary, the daughter and heiress of Richard Wood. They had many children, and Stephen was their sixth son.

Of Stephen's boyhood there is nothing known. In his nineteenth year he was sent to Cambridge and was entered a pensioner of Corpus Christi College under the tuition of Mr. Moss, the future dean of Ely. Having taken the degree of Bachelor of Arts, he was pre-elected into a fellowship into which he was admitted in the following year. In the same year (1703) he obtained his degree of Master of Arts. Some time afterwards he entered into orders and became a Bachelor of Divinity in 1711. During his residence in the college, a period of about twelve years (1696-1708 or 1709), he applied himself with great zeal to the study of natural and experimental philosophy.

In William Stukeley,[2] afterwards M. D., F. R. S., who came

[1] Read before the Johns Hopkins Hospital Historical Club, April 20, 1903.

[2] William Stukeley, 1687-1765. In his undergraduate days he "went," he says, "frequently asimpling, and began to steal dogs

in 1704 to live in Corpus Christi College, Hales seems to have found a very congenial companion, though Stukeley was the younger by ten years. Together the two used to ramble over Gogmagog Hills and the bogs of Cherry-Hunt-Moor to gather simples. One carried in his pocket Ray's Catalogue of Plants, to which Stukeley, who was a ready draughtsman, added a map of the country to guide them in their walks. Sometimes they collected fossils from the gravel and chalk pits and sometimes hunted butterflies, having contrived an instrument for taking them. The two friends also studied anatomy together, dissecting frogs, dogs and other animals; while Hales devised an ingenious method of obtaining a preparation of the lungs in lead. They moreover studied chemistry and "repeated many of Mr. Boyle's experiments" and prepared various substances, "some of use, some of curiosity."

At this time Vigani,[3] of Verona, the first professor of chemistry at Cambridge, was lecturing at Queen's College Cloysters, and thither Hales and Stukeley used to repair, and were also witnesses of the chemical operations which Vigani was accustomed to perform in a room in Trinity College which had formerly been the laboratory of Sir Isaac Newton. Hales was also a student of astronomy and constructed a brass machine for demonstrating the movements of the planets, and of this Stukeley made a sketch.

About 1710 Hales was made perpetual curate of Teddington. He afterwards accepted the living of Porlock, in Somerset, vacating his fellowship in so doing, but this living he soon exchanged for that of Farringdon, in Hants. Teddington he made his home, though he appears to have occasionally resided in Farrington.[4]

The date of his marriage seems to be uncertain. His wife was Mary, daughter and heiress of Dr. Newce, rector of Halisham. In 1721 Mary died,[5] leaving no children. Hales never married again.

In 1718 Hales was elected Fellow of the Royal Society and became a member of the council of that body in 1727. In 1732 he was appointed one of the trustees of the newly-founded colony of Georgia.[6] In 1733 the University of Oxford conferred upon him the honorary degree of D. D., which was the more significant in that Hales had pursued all his studies at Cambridge In 1739 he received the Copley medal. In 1750, on the death of Frederick, Prince of Wales, he was appointed, without his solicitation or even knowledge, clerk of the closet and almoner of Her Royal Highness the Princess Dowager. In 1753 he became one of the eight foreign members of the French Academy in the place left vacant by the death of Sir Hans Sloane, president of the Royal Society.[7]

The work and writings of Hales embrace a very broad field, which includes chemistry, botany, physiology, medicine and public hygiene, not to mention sermons and temperance tracts. In 1719 he reported before the Royal Society some experiments which he had lately made on the effect of the sun's warmth in raising the sap in trees. This procured him the thanks of the Society, which also requested him to continue his research. "With this request," writes the biographer,[8] "which was like the charge given by Pharaoh's daughter to the mother of Moses, to take care of her son, Hales complied with great pleasure, and on the 14th of June, 1725, he exhibited a treatise in which he gave an account of his progress." At the request of the Society this treatise was published an appeared in 1727 under the following title: "Vegetable Staticks; or, an account of some statical Experiments on the Sap in Vegetables: being an Essay towards a Natural History of Vegetation; also a Specimen of an Attempt to analyse the Air by a great Variety of chemio-statical Experiments, which were read at several Meetings of the Royal Society." The "Vegetable Staticks" was so well received that a second edition was published in 1731. In the preface of this edition the author promised to add a second volume, and in 1733 he published his second famous work, entitled "Statical Essays: containing Hæmostaticks, or an Account of some Hydraulick and Hydrostatical Experiments made on the Blood and Blood-Vessels of Animals; also an Account of some Experiments on Stones in the Kidney and Bladder; with an Enquiry into the Nature of these anomalous concretions. To which is added an Appendix containing Observations & Experiments relating to several Subjects in the first Volume." These two books were again edited under the title, "Statical Essays, Vols. I & II."

Through the "Statical Essays" Hales came to have an international reputation, for not only was the first volume translated into French by Buffon, and the second into the same language by Boissier de Sauvages (1744), but before long there appeared German and Italian translations.[9]

If one were required to state the essential and distinguish-

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and dissect them" and once when at home, he "made a handsome sceleton" of an aged cat. Hales and Dr. J. Gray of Canterbury, were his botanical associates and he made large additions to Ray's *Catalogus Plantarum circa Cantabrigiam*.—D. N. B.

[3] John Francis Vigani, 1650?-1712, born in Verona; probably came to England about 1682, to Cambridge about 1683, where he gave private lessons in chemistry and pharmacy. In 1703 a grace was passed by the senate for "investing with the title of professor of chemistry John Francis Vigani, a native of Verona, who has taught chemistry with reputation for twenty years previously."—D. N. B.

[4] Letter preserved in the Library of the Royal Society, F. D.

[5] See L. L., III, 507.

[6] In 1734, Hales published a sermon which he had delivered at St. Brides, before the rest of the trustees of the colony, his text being Gal. VI, 2.

[7] "*Stephen Hales*, D. D., is elected member of the Royal Academy of Sciences at *Paris*, in the room of Sir *Hans Sloane*, Bart. Deceased." G. M., Feb., 1757, XXIII, 103.

[8] Peter Collinson, 1694-1768, F. R. S., 1728; naturalist, antiquary, and merchant; Quaker.

[9] These works contained copious notes by the translators and to the volume on Hæmostatics two memoirs by de Sauvage had been added one on inflammation and one on fevers. The two volumes were re-edited in 1779 as one book. In 1748 the two French works were translated bodily (memoirs, notes and all) into German. In 1750, M. A. Ardinghelli published her translation, Emastatica, in Naples; the text was translated from the English; the notes from the French of de Sauvage.

ing characteristics of these essays, the unhesitating reply would be that the work which they describe is quantitative. In everything that Hales did, one sees this constant effort to be exact. Qualitative results were never sufficient; Hales must needs weigh and measure everything, and every phenomenon must be expressed numerically so as to serve as the basis of calculations and thus lead to new discoveries.

It will be remembered that Hales studied chemistry under Vigani and that Vigani was the first professor of chemistry at Cambridge. In fact, Hales' life fell very early in the history of scientific chemistry, in that period when experimentation, though often suggestive, is usually indefinite and always incomplete.[10] Hales made a careful study of gases, or, as he called them, "air." To him air was an element which entered into the composition of a surprising number of substances, and so he studied the generation and absorption of "air" during distillation, fermentation and many other chemical processes. In his experiments he must have prepared hydrogen, oxygen, hydrochloric acid, carbon dioxide and ammonia, and though they were all "air" to him, he introduced some important improvements in the way of chemical apparatus and manipulations, and was perhaps the first chemist to employ quantitative methods.[11]

With respect to the purely botanical part of the "Statical Essays," suffice it to refer to a statement of Sachs. This well-known botanist writes that in the revival of plant physiology which took place in the eighteenth century, the work of Hales was the most original and most important contribution.[12] It was in honor of Hales that John Ellis, the "bright star in Natural History," as Linnaeus has called him,[13] named a newly discovered genus of plants *Halesia*.[14]

The contributions of Hales to animal physiology are many and important. His experiments in this field are described partly in the first volume of the Essays, but chiefly in that section in the second volume which is devoted to hæmodynamics A discussion of this part of Hales' work will, however, be reserved for another communication.[15]

In 1739 he published an octavo volume entitled: "Philosophical experiments: containing useful and necessary instructions for such as undertake long Voyages at Sea; showing how Salt-water may be made fresh, wholesome, and how Fresh Water may be preserved sweet; how Biscuits, corn, &c., may be secured from the Weavel, Maggots, and other Insects; and Flesh preserved in Hot Climates by salting Animals whole; to which is added an account of Experiments and Observations on Chalybeate or Steel-waters, with some Attempts to convey them to distant places, preserving their virtues to a greater degree than has hitherto been done; likewise a proposal for cleansing away Mud, &c., out of Rivers, Harbours, and Reservoirs." This work, which contained so many useful instructions for voyagers, was dedicated to the Lords of the Admiralty.

In the same year he reported to the Royal Society an account of some "further experiments towards the discovery of a medicine for dissolving the stone in the kidneys and bladder, and preserving meat in long voyages," and it was for this that he received the gold medal of "Sir Godfrey Copley's donation." In the following year he published an account of some experiments and observations on Miss Stephens' medicines for dissolving stone, in which their dissolving power was inquired into and demonstrated. This work on stone was subsequently translated into French.[16]

The contributions of Hales to the "Philosophical Transactions" were numerous and dealt with a great variety of topics. Besides those which are mentioned elsewhere in this article the following may be enumerated:

A Method of conveying Liquors into the Abdomen during the operation of Tapping. IX, p. 8.

A Proposal to bring Small Passable Stones Soon and with ease out of the Bladder. IX, p. 159.

Remarks on Dr. Cromwell Mortimer's paper on a new metallic thermometer. IX, p. 407.

A Proposal for Checking in some Degree the Progress of Fire. IX, p. 498.

Remarks concerning some Electrical Experiments. IX, p. 534.

Of the strength of several of the principal Purging Waters, especially that of Jessop's Well. X, p. 48.

Of some Trials to keep Water & Fish sweet, with Lime-water. X, p. 551.

Of the great Benefit of Blowing Showers of Fresh Air up through Distilling Liquors. X, p. 635.

Of Some Trials to cure the Ill Taste of Milk which is occasioned by the Food of Cows, either from Turnips, Cabbages, or Autumnal Leaves, &c. Also to Sweeten Stinking Water. X, p. 642.

Whenever these papers seemed to him to be of value to the public or to deal with topics of general interest, he would

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[10] "He (Hales) had learned to interrogate but not to cross examine nature." F. H. Butler: History of Chemistry, Encyclo. Brit.

[11] See Herman Kopp: Geschichte der Chemie. Braunschweig, 1845.

[12] F. D.

[13] D. N. B.

[14] Title: "Of the Plants Halesia and Gardenia." "In a letter from John Ellis, Esq., F. R. S., to Philip Careret Webb, Esq., F. R. S. The intent of the letter is to exhibit the characters of two new genera of plants growing in Mr. Webb's garden, which Mr. Ellis calls after Dr. Hales of Teddington and Dr. Garden of South Carolina." P. T., XI, 508.

Francis Darwin appears to be in error in the statement that John Ellis was governor of Georgia. The governor was Henry Ellis, F. R. S., arctic explorer and hydrographer, also governor of Nova Scotia.

[15] See Bulletin of the Johns Hopkins Hospital for July, 1904.

[16] "Etat de la Medicine, etc., par M. Clifton," translated by M. l'Abbé des Fontaines, "avec les Espériences sur le Remede de Mlle. Stephens, fait par M. Hales," etc., translated by M. Cantwell of the Royal Society, doctor of the Faculty of Montpellier. Paris, 1742.

publish a popularized version in the *Gentleman's Magazine*." But besides these abstracts this magazine contains numerous articles from his pen, of which the following are the more important:

A description of a Back-Heaver, *which will winnow and clean corn, both much sooner and better, than by the common methods of doing it.* July, 1745, XV, 353.

A Description *of a very great Improvement which is made to the* Back-Heaver; *which will not only winnow corn much sooner and better than any other methods hitherto used; but will also clean and clear it of very small Corn, Seeds, Blacks, Smut Balls, &c., to such perfection as to make it fit for Seed Corn.* July, 1747, XVII, 310.

A Description of a Sea Gage, to measure unfathomable Depths. May, 1754, XXIV, 215.

A Proposal for the more speedily and effectually curing Men, Ships, and Goods, of Pestilential Infection. Dec., 1754, XXIV, 543."

Rational and easy method to purify the Air, and regulate its heat in Melon-Frames and hot Green-houses. April, 1757, XXVII, 165.

The year 1741 is ever memorable in the history of Hygiene, for it was in this year that three persons of very different stations in life conceived the idea of constructing ventilators. These persons were Sutton, a coffee-house keeper in Aldersgate Street; Martin Triewald, captain of mechanics to the King of Sweden, and the Rev. Dr. Hales.

The methods devised by Hales and Triewald seem to have been identical, and the history of their invention is told by Hales in his book on Ventilators published in 1743. From the introduction of this work, it appears that in the beginning of September, 1740, Hales wrote to Dr. Martin, the physician to Lord Cathcart, the general of the forces which lay embarked at Spithead, for an expedition in America, to propose (besides the usual sprinkling between decks with vinegar) the hanging up very many cloths dipped in vinegar in the proper places between decks, in order to make the air more wholesome: and in case an infectious distemper should be in any ship, to cure the infection with fumes of burning brimstone. "It was from these considerations, which often recurred to my Thoughts, that it occurred to me in the March following that large Ventilators would be very serviceable, in making the Air in Ships more wholesome; this I was finally so fully satisfied of, that I immediately drew up an account of it; several coppies of which were communicated, both by myself and others, to many Persons of Distinction and Members of the Royal Society: before whom I laid a large Account of it . . . .

"November the 6th following . . . . Martin Triewald, Captain of Mechanics *and Military* Architect *to the King of* Sweden, *and Fellow of the* Royal Society *at* London, *in a Letter to* Cromwell Mortimer, M. D., and secretary of the Royal Society, says that this Spring he had invented a Machine, for the use of his Majesty's Men-of-War, which went to block up Petersburg, in order to draw out the bad Air from under their Decks, the least of which does exhaust 36172 cubick Feet of Air in an Hour . . . . "

"It was a very extraordinary Circumstance that two Persons at so great a distance from each other, without getting a Hint of it, one from the other, should happen to hit on inventing a like useful Engine."

For this invention Triewald was granted a privilege for life by the King and Senate of Sweden. He then wrote a "deduction" on the usefulness of ventilators which the King caused to be distributed among his naval officers. This "deduction" was read before the Royal Society in 1742. In it Triewald recommends the use of ventilators "in Hospitals and Barracks for the sick, Men-of-War and Hospital Ships."

The book, of which the introduction above quoted forms a part, was dedicated by Hales to "the Commission for executing the office of Lord High Admiral," and in the list of its members is found the name of the Right Honourable Lord Baltimore. An idea of its contents may readily be obtained from its very lengthy title, which is as follows: "A Description of Ventilators: whereby Great Quantities of Fresh Air May with Ease be conveyed into Mines, Goals, Hospitals, Work-Houses and Ships in Exchange for their *Noxious Air*. An Account of their GREAT USEFULNESS in many other Respects: As in Preserving all Sorts of Grain Dry, Sweet, and free from being Destroyed by WEAVELS, both in GRAINARIES and SHIPS: And in Preserving many other Sorts of Goods. As also in drying, CORN, MALT, HOPS, GUN POWDER, &c., and for many other useful purposes."

The Hales ventilators were nothing more than ingeniously contrived bellows which sucked the foul air from the rooms or spaces to be ventilated and blew it out of doors. When large, these bellows were worked by means of a wind-mill; when small, by hand. The ventilator fixed in Newgate by order of the Lord Mayor and Aldermen of London was a large one and was connected by a system of tubes with twenty-four wards. It is figured and described in detail in the *Gentleman's Magazine*."

Not content with playing the part of a mere inventor, Hales added to that role that of the philanthropist, for seeing that it would be of great benefit to humanity, he wrote constantly on the subject and used what influence he had to obtain the introduction of his ventilators. Success crowned his efforts. In a few years his ventilators had been put not only into Newgate and the Savoy prison,[9] but also into the Winchester

[7] See G. M., July, 1755, XXV, 310. April, 1747, XVII, 200. March, 1756, XXVI, 130. December, 1749, XIX, 554. February, 1756, XXVI, 78. September, 1757, XXVII, 410. November, 1757, XXVII, 503.

[8] The method consisted essentially in fumigation by means of burning a mixture of brimstone and charcoal. Persons subjected to the fumes were to have their faces properly covered to prevent suffocation.

[9] "*A description of Dr. Hales* on Ventilators *fixed in* Newgate; where *being worked by a Windmill they draw foul Air out of the several Wards; which were made by* Mr. Stibbs, *Carpenter in* Fore Street, London Wall." G. M., April, 1752, XXII, 179.

Gaol,[30] the Durham County Gaol,[31] then the Gaols of Shrewsbury,[32] Northampton [33] and Maidstone.[34] The results were remarkable. During the first four months after their introduction into Newgate, the death rate was reduced by more than fifty per cent, while in the Savoy prison the rate fell from fifty or a hundred per annum to one or two per annum. Equally gratifying were the results at the smallpox hospitals. This institution contained thirty-two rooms, each accommodating two patients, and here the mortality was soon reduced to two-thirds of what it had formerly been.

Meanwhile at the recommendation of the French Academy the whole French fleet had been equipped with Triewald ventilators and many English vessels had adopted those devised by Hales. Excellent results followed, as can be seen from such letters as the following, which was published in the *Gentleman's Magazine:*[35]

A letter from Captain Ellis, on his late Arrival from a Guinea Voyage, to the Rev. Dr. Hales.

Sir,

Could anything increase the pleasure I have in a literary intercourse with you, it would be to find that it answered your end in promoting the publick good. . . . . Those [ventilators] of your invention which I had were of singular service to us; they kept the inside of the ship cool, sweet, dry, & healthy: The number of slaves which I buried was very inconsiderable, and not one white man of our crew (which was 34) during a voyage of 15 months; an instance very uncommon. The 340 negroes were very sensible of the benefits of a constant ventilation, and were always displeased when it was omitted. Even the exercise had an advantage not to be despised among people so much confined."

Ellis adds, however, that we must not forget that there are other causes of sickness at sea, infections brought on board, bad food and insobriety. On the last factor he dwells at some length, and to the unusual sobriety of the crew he ascribes some of their good health. His conclusion is as follows: "Could I but see the immoderate use of spirituous liquors less general, and the benefit of ventilators more known and experienced, I might then hope to see mankind better and happier."

It was without doubt the receipt of such letters as these that prompted Hales to report before the Royal Society "On the Great Benefits of Ventilators in many Instances in Preserving the Health and Lives of People, in Slave and Transport Ships."[36]

The *Gentleman's Magazine* also contains the following articles: On keeping corn sweet in heaps: Dec., 1745, XV, 640; Dr. Hales' *method to keep corn sweet in sacks:* July, 1745, XV, 354; *An Account of several methods to preserve* CORN *well by* VENTILATION: June, 1746, XVI, 315.

The last of the articles which have just been enumerated was accompanied with plates and contained a careful and minute description of the construction of granaries, with calculations regarding the size of the ventilator and the amount of air required for drying a certain amount of a given kind of grain in layers of such a depth in granaries of such a size and so forth, all this showing his painstaking accuracy and his detailed knowledge of the subject.

The ventilator which was invented by Sutton, the coffee-house keeper above mentioned, was "of another construction,"[37] being designed "to draw off the foul air on board ships by means of the cook-room fire."[38] Sutton did not fully recognize the importance of his idea, so that it would have been forgotten had it not been for Dr. Mead, who brought it to the attention of the Royal Society. The method was so simple and satisfactory that it could not but replace in part at least the method of Hales. But, as the editor of the *Gentleman's Magazine* says, "The public, however, is not the less indebted to the ingenuity and benevolence of Dr. Hales, whose ventilators came more easily into use for many purposes of the greatest importance to life, particularly for keeping corn sweet, by blowing through it fresh showers of air, a practice very soon adopted by France, a large granary having been made under the direction of Du Hamel, for the preservation of corn in this manner, with the view to making it a general practice."[39] Here the editor refers to Duhamel du Monceau,[40] F. R. S., the celebrated French botanist and agriculturist, who, at the suggestion of Hales, equipped one of the public granaries with a wind-mill and ventilators to draw up air through the grain.

It was probably through Duhamel's influence that Hales persuaded Louis XV to introduce his system of ventilating into the French prisons in which British soldiers were confined.[41] On this occasion, writes the chronicler, "the venerable patriarch of Teddington was heard merrily to say 'he hoped no body would inform against him for corresponding with the enemy.'"[42]

Among Hales' numerous contributions to the literature of stone in the bladder and kidney, one is of special interest as showing his method of dealing with this question and his zeal in exposing quackery. It is a letter to the editor of the *Gentleman's Magazine*,[43] which runs thus:

"*Mr.* Urban, If you please to put the following Remarks on the *Liquid Shell* into your next Magazine, you will do good service to the publick. I am, Sir, &c.

"*Some* Remarks on the *boasted* Liquid Shell. The newspapers having frequently repeated a long advertisement in praise of the *Liquid Shell*, as a powerful dissolvent for the stone and gravel, I thought it of importance to enquire, by proper tryals, whether it had that boasted efficiency or not; and, if not, to caution

[30] "*An Account of the good Effects of Ventilators, in* Newgate *and the* Savoy Prison." G. M., February, 1753, XXIII, 70.

[31] "*A further Account of the Success of Ventilators &c.*" G. M., March, 1754, XXIV, 115.

[32] G. M., March, 1754, XXIV, 114. See also G. M., August, 1750, XX, 379.

[33] P. T., X, 641.

[34] P. C., page 275.

[35] Henri Louis Duhamel du Monceau, 1700-1782.

[36] See Michaud: Biographie Universelle, article on Hales by Lefebvre Cauchy.

[37] F. D.

[38] G. M., October, 1746, XVI, 520.

people against throwing away their money, and hazarding their lives, by the use of an unefficacious medicine.

"Having therefore procured some of the *Liquid Shell*, which is a clear transparent liquor, I put into it a human stone formed in the urinary passages, upon which a very white sediment precipitated; and there was a like white sediment when a few drops of spirit of harts-horn were dropped into the same liquor; which fully proves that it was in both cases the lime of burnt shell, and not the parts of the dissolved stone as is pretended; for there was no stone put in with the spirit of harts-horn. Besides this precipitated matter is much too white for any part of dissolved stones.

* * * * * * *

"And, whereas, it is said in the advertisement, 'That, if the stone be put into a vial of the Liquid Shell, in a moderate sand heat, it will in a few hours be dissolved or broken to pieces:' On the contrary, it has been found, that, on putting human stones, of different degrees of hardness, into a vial of the Liquid Shell, they have *not* been dissolved, *nor* broken in pieces, though they continued in that state, not a few hours only, but many days; the last four hours of which time, the vial of Liquid Shell was put into scalding hot water, ... "

"Soap lie," he then states, is a powerful solvent of stones, but on evaporating the medicine to dryness only a minute quantity of this material was obtainable, and he therefore concludes thus:

"Hence we see how improbable it is that *this Liquid Shell* 'given every four hours in the quantity of 70 drops in a dose,' should have any efficiency to dissolve stones in the body," especially since it has been shown that "three pints of lime water a day, with a considerable quantity of soap, have been found necessary to be taken, in order for any probability of success, (as may be seen in the *Edinburgh* Medical Essays) . . . . "

Among the book notices for the following year is "Dissertation on the Liquid Shell pr. 6 d."[20] This pamphlet, like the article in the *Gentleman's Magazine*, was anonymous.

Dr. Holmes has made us all familiar with the subject of Bishop Berkeley's "Tar Water." In the words of a wag writing in the *Gentleman's Magazine*,[21]

"To ev'ry med'cine is assigned its part,
"*Sena* is purging, *saffron* warms the heart;
"Blood sweet'ning juice to *sassafras* is given,
"To *tar drink*—every virtue under heaven."

On the subject of tar water Hales shows a praiseworthy caution. He does not deny its efficacy, but he does not advocate its use. His only publication in the *Gentleman's Magazine*[22] is a letter received by him from Bishop Berkeley, upon the contents of which he makes no comment. In the book which he wrote on this subject, he confines himself entirely to the chemistry and preparation of tar water. This book, which bears the following title: "An Account of some Experiments and Observations on Tar-Water Wherein is shown the Quantity of Tar that is therein. Which was read before the Royal Society. By Stephen Hales, D. D., F. R. S.," closes with the following paragraph: "It is hoped that the Light given by these Researches, may be of use in Skillful Hands, for regulating and adapting the due Proportions of the acid and the oily Principles, to different Cases and Constitutions. This is the proper Province of the Physician, which I am in no ways qualified to meddle in."

Among the subjects which Hales regarded as of great importance was the liquor question. In a letter dated 1758, written by him to Mark Hildesley, Bishop of Sodor and Man, he speaks of having for the last thirty years borne public testimony against drams "in 11 different books and newspapers," and adds that this circumstance "has been of greater satisfaction to me than if I were assured that the means which I have proposed to avoid noxious air should occasion the prolonging the health and lives of a hundred millions of persons."[23]

His most important pamphlets on this subject are entitled "A Friendly Admonition to Drinkers of Brandy and other Distilled Spirits" (published anonymously), and later, "Distilled Spirituous Liquors the Bane of the Nation." In his treatment of even these topics, the scientific bent of his mind is seen, for in the second of these pamphlets, he tries to arouse the interest of the landed gentry and the farming population on the ground that dram drinking decreases the appetite and lowers the demand for food. Then, not contented with anything but quantitative statements, he declares that according to his calculations the country loses £600,000 per annum owing to the distilleries in London alone.[24]

We have considered Stephen Hales as a scientist and as a philanthropist, but the question now arises, What was going on in Teddington all this time? Did the charity of Dr. Hales begin at home?

History does not record any murmurs of neglect coming from his flock. It is even said that he made some of his women parishioners do public penance for irregular behavior.[25] We are told that the little church of St. Mary owed much to his care. He enlarged the church yard "by prevailing on the lord of the manor."[26] He superintended the building of a new tower and aisle, for which he contributed £200 out of the £592 which it cost.[27]

Under his supervision the water supply of the parish was greatly improved, and Hales records in the parish register in a manner quite characteristic that the outflow was such as to fill two quart vessels in "3 swings of a pendulum, beating seconds, which pendulum was 39 + 2/10 inches long from the suspending nail to the middle of the plumbet or bob."[28]

"Peg" Woffington,[29] the celebrated actress, was one of his parishioners, and built and endowed an almshouse at Teddington, and at her death a tablet in her memory was placed in the north aisle of St. Mary's.[30]

Hales' connection with the smallpox hospital is shown in

[20] G. M., November, 1747, XVII, 548.
[21] G. M., February, 1747, XVII, 81.
[22] G. M., February, 1747, XVII, 64.

[23] Butler: Life of Hildesley, 1799. F. D.
[24] F. D.
[25] Parish register, F. D.
[26] L. L., III, 505, note 14.
[27] Margaret Woffington, born in Dublin, 1714, died, 1760.
[28] L. L., II, 506.

the title of an account of this institution which appeared in the *Gentleman's Magazine.*[38] This title reads as follows:

"Middlesex. *Of the County Hospital for the* SMALL POX, *the Duke of* MARLBOROUGH *and the Lord Bishop of* WORCESTER, *Presidents, Sir* HUGH SMITHSON *and Sir* ROVER NEWDIGATE *Barts. the Hon. Col.* BOCKLAND *and the Rev. Dr.* HALES *Vice-Presidents.*

"For several years Hales was honored with the esteem and friendship of his Royal Highness Frederick, Prince of Wales, who frequently visited him at Teddington, from his neighboring palace at Kew, and took a pleasure in surprising him in the midst of those curious researches into the various parts of nature which almost incessantly employed him."[39]

His contemporaries admired his "social virtue and sweetness of temper" and "the constant serenity and cheerfulness of his mind."[40] Pope, who was his neighbor and of whose will Hales was one of the witnesses,[41] was heard to say, "I shall be very glad to see Dr. Hales; I always love to see him; he is so worthy and good a man."[42]

To the end of his long life his mind was ever actively planning scientific experiments and benevolent enterprises. In November, 1760, his signature appears on the parish register for the last time. On Sunday, January 4, 1761, he died after a slight illness. His death was the occasion of the following article, which appeared in the January number of the *Gentleman's Magazine:*[43]

"*The following Character of the late Dr.* Hales, *may be relied upon in every particular, and it is to be regretted that we have not more particulars concerning his useful Life from the same hand. On Sunday* the 4th instant, died, at his parsonage-house at *Tedington*, universally lamented, in the 83rd year of his age, the Rev. Dr. *Stephen Hales*, F. R. S., member of the royal academy of sciences at *Paris* and clerk of the closet to her Royal Highness the Princess Dowager of *Wales*. If any man might ever be said to have devoted his whole life to the public, to all mankind, it was Dr. *Hales*. He possessed a native innocence and simplicity of manners, which the characters of other men, and the customs of the world, could never alter; and though he often met with many unworthy objects of his kind and charitable offices, yet they never once lessened his natural and unwearied disposition of doing good and relieving distress. His temper, as well as the powers of his understanding, were happily fitted for the improvement of natural philosophy, possessing, as he did, in an uncommon degree, that *industry and patient thinking*, which Sir *Isaac Newton* used modestly to declare, was his own only secret by which he was enabled so fortunately to trace the wonderful analysis of nature. Dr. *Hales* began his inquiries into natural knowledge very early in life, and he continued it uniformly as his darling amusement, being engaged in experiments until within a few weeks of his death. His industry had this farther excellence, that it was always pointed at the general good of his fellow creatures, agreeable to the almost unlimited benevolence of his heart; and being animated with the success of some of his more useful discoveries, his knowledge appeared to everybody near him to feed his mind with a nourishment which gave him, in the decline of his life, and even in its last stages that vigor and serenity of understanding, and clearness of ideas, which so few possess, even the flower of manhood; and which he used often to say, he valued as the most perfect of human pleasures.

"

"There are two things in his character, which particularly distinguish him from almost every other man; the first was, that his mind was so habitually bent on acquiring knowledge, that, having what he thought an abundant income, he was solicitous to avoid any farther preferment in the church,[44] lest his time and attention might thereby be diverted from his other favorite and useful occupations.

"The other feature of his character was no less singular: He could look even upon wicked men, and those who did him unkind offices without any emotion of particular indignation; not for want of discernment or sensibility; but he used to consider them only as those experiments which, upon trial, he found could never be applied to any useful purpose, and which he therefore calmly and dispationately laid aside."

In accordance with his own directions he was buried in the vestry under the tower of St. Mary's which he had built eight years before. The tablet over his grave tells us that—

"Here is interred the body of Stephen Hales, D. D., clerk of the closet to the Princess of Wales, who was minister in this parish 51 years. He died the 4th of Jan., 1761, in the 84th year of his age."

In the September number of the *Gentleman's Magazine* of the following year we find this notice:[45]

"Thursday the 2nd was opened in Westminster Abby, a fine new monument,[46] erected by Mr. John Wilton, statuary to her majesty, at the expense of the Princess Dowager of Wales, to the memory of Stephen Hales, D. D. & F. R. S., Clerk of the closet to the Princess Dowager, minister of Teddington in Middlesex, and rector of Farrington in Hants; grandson of Sir Robert Hales, of Beakesbourne in Kent, Bart. & uncle to the present Sir Thomas Hales. He died in January, 1761, aged 82 years."

There is, then, a monument to Stephen Hales in Westminster erected by the mother of George II, but it is not by means of this piece of marble that the memory of Stephen Hales is kept green among us. He has left us a memento more unique and enduring in the "Statical Essays" and the Hales manometer.

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1. The separate publications of Hales.
2. Numerous articles by or referring to Hales in the Phil-

[38] G. M., June, 1747, XVII, 270.
[39] P. C., 277.
[40] F. D.
[41] Courthope: Life of Pope, F. D.
[42] F. D. In the phrase "Plain parson Hale," (Moral Essays, Epistle II) Pope doubtless refers to Hales whose correct name unfortunately could not be made to rhyme with "fail" in the preceding line.
[43] G. M., January, 1761, XXXI, 32.

[44] The King offered Hales the canonry of Windsor which the latter, however, declined. L. L. and P. C.
[45] G. M., September, 1762, XXXII, 444.
[46] For epitaph see L. L., III, 507, note 19.

osophical Transactions of the Royal Society of London, abridged, London, 1809. Designated P. T.

3. Numerous articles by or referring to Hales in the *Gentleman's Magazine*, London. G. M.

4. An especially important article in G. M., June, 1764, XXXIV, 273, entitled, "*Some Account of the Life of the Late excellent and eminent* STEPHEN HALES, *D. D., F. R. S., Chiefly from Materials communicated by* P. COLLINSON, F. R. S." P. C.

5. D. Lysons: Environs of London, London, 1795, Vol. III. L. L.

6. In a number of instances the author has been unable to reach the original sources and has quoted from the very excellent account of Hales given by Francis Darwin in the Dict. National Biography, XXV, 33. Such quotations are designated by the initials F. D. which follow the title of the original source when this is known.

7. Other articles in the Dict. Nat. Biog. D. N. B.

A CASE OF CANCER OF THE MAMMA CURED BY MEANS OF ROENTGEN RAYS.

COMMUNICATED BY PROFESSOR E. SCHIFF (*Vienna*).

The first note on cure of cancer by Roentgen rays was given by Gocht.[1] It referred to a woman of 54 years who had come to be treated of a cancer on the right mamma, ulcerated and inoperable. Considering the pains and *solaminis causa* the patient was submitted to a daily treatment. The patient felt relieved and the pains entirely disappeared. The 7th day sudden elevation of temperature and appearance of erysipelas extending from the thorax to the back and to the right arm. After a few days profuse hemorrhages out of the ulcerated cancer and death on the 27th day, caused by cachexy and sepsis.

Another patient, aged 45, suffered from recurrence of cancer of the mamma which had been already repeatedly operated on and for the last time in 1896. Also in this case the pains decreased rapidly and reappeared only when the treatment was interrupted. No influence on the cancerous tissue was to be observed.

Later appeared the publications of Magnus Moeller,[2] Sioegren and Sederholm,[3] Steubeck,[4] and of many others.

November 6, 1901, I presented to the Imperial Medical Society of Vienna a man affected with an epithelioma suborbiculare, which had been cured by Roentgen rays. Some time later I presented two other similar cases before the same society and which had also been successfully treated. Recently Mikulicz and Fittig[5] published a very instructive case, and Exner[6] described three analogous cases.

If I now insist now with more details on a case of a cancer mammæ cured by Roentgen rays accompanying it with some drawings, I do so for two reasons:

First, on account of the most favorable result of the cure and also because I was enabled to study this case histologically. Mrs. N. N. was sent to me by Dr. Schnitzler on February 7, 1903. She showed the following symptoms: The left thorax was invaded by a tumor with large basis and of a very solid consistence. This tumor extended from the left sternal margin to the axillary cavity where it reached the glands and formed a hard bunch. On its greatest wideness the tumor had 8 centimeters and its highest elevation was 5 centimeters. The surface was ulcerated, giving issue to a fetid matter, very slightly bleeding even when slightly touched. The inferior periphery showed ten or twelve small tumors of about the size of a hazelnut, also very slightly bleeding. On the back of the patient were five similar noduli. Beneath the above-mentioned bunch of the armhole existed a crateriform cavity wide enough to admit a pigeon egg. The edges were gangrenous and the basis necrotic and full of purulent matter. The glands, both supra and infraclavicular, hard and resistent. The patient said that she suffered since 11 years from pungent pains. Dr. Schnitzler's diagnosis was: Inoperable cancer en cuirasse of the left mamma with lenticular metastases of the cutis.

Although I was for a long time anxious to catch a case of this kind in order to try a Roentgen cure, I confess that the present case left me very little chance of success. *Solatii causa*, I nevertheless decided to proceed, and already, after the third sitting, the pains considerably decreased and the purulent secretion diminished. I then took the photograph of the patient (Fig. 1), which already shows a modified appearance of the state on February 7. The ulceration was considerably cleaner and scarcely purulent, the tumefaction of the heart nearly wholly reduced and the cutaneous metastases in way of full reconstitution and their volume considerably lessened.

During the treatment I could observe nearly daily an improvement. In the interval appeared slight phenomena of reactive inflammation of the surrounding skin, and so I interrupted the Roentgen treatment. The pathological process showed evidently favorable modification.

June 5 I noticed that, excepting some superficial excoriated parts, a flat scar crossed by some enlarged capillar vessels had taken the place of the former tumor. The cutaneous metastases had disappeared and the groups of glands on the supra-

[1] Fortschritt auf dem Gebiet der Roentgenstrahles, Bd. I, Heft 1.
[2] Bibliotheca Medica, 1900.
[3] Fortschr. a. d. Geb. d. Roentgenstrahles, IV.
[4] Archives d'électricite médicale, 1901.
[5] Beiträge zur klinischen chirurgie, Bd. 37.
[6] Wiener klinische Wochenschrift, 1903.

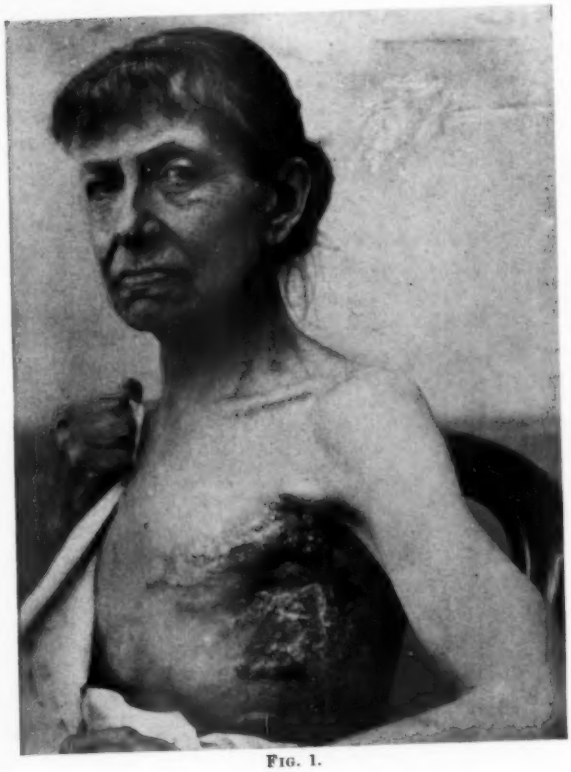
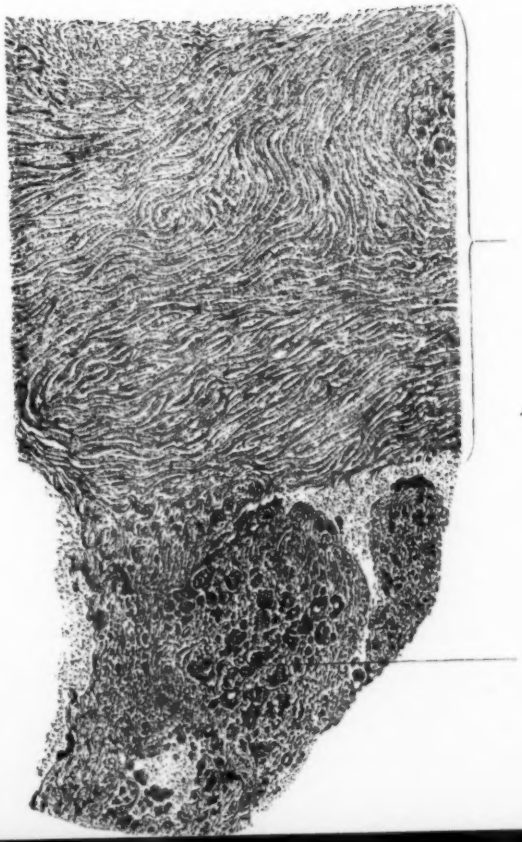
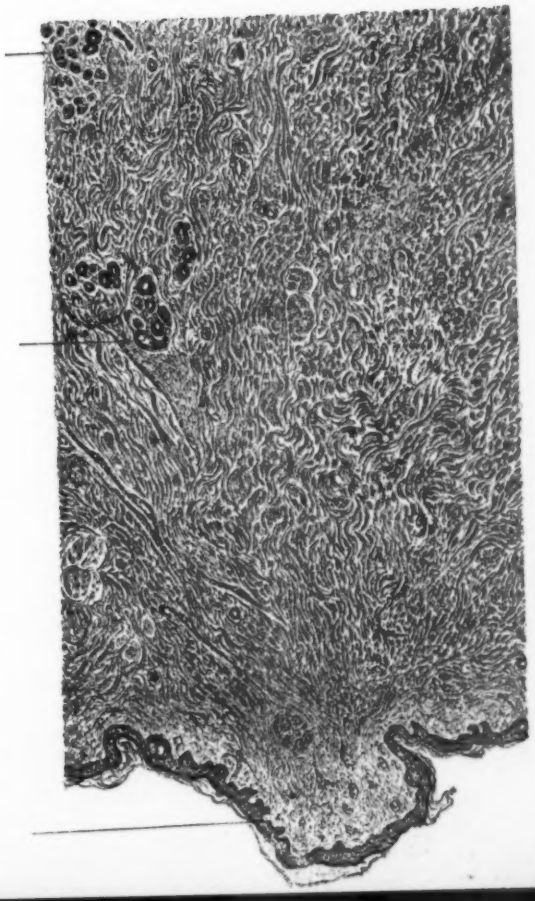


FIG. 1.

FIG. 2.





and infraclavicular region had greatly decreased and were soft (Fig. 2). The general state of the patient had very much improved.

In order to know exactly the histological condition of the case, I requested Dr. Stoerk, of the Pathological Institute of the Vienna University, to make a microscopic examination of some excised parts. The examination included:

1. A fragment of a lenticular nodulus of the back which by the treatment was notably diminished in its size.

2. Fragment of the granulated surface of the cancerous ulceration.

3. A fragment of the region in course of reconstitution surrounding the ulcerated surface and excised near the precedent fragment.

Dr. Stoerk gave the following account:

1. The greater part of this fragment consists of a tissue of large fibers very poor of nuclei and of the type cicatricial tissue; it consists of threads of homogeneous fibers. In the interstitials of these fibers mono- and polynuclear leucocytes; in the deeper part of this fragment remains of cancerous tissue in shape of small bundles of solid cellules, among which is seen a stroma of very thin fibers distinct from the larger fibers above mentioned.

2. Section from the fragment of the ulcerated surface showing the normal appearance of a granulated tissue with a great number of new-formed capillary vessels ranged in typical order.

3. In the part where the epidermis begins to be repaired it is of course very delicate. Underneath a large layer of cutis and in the basis exists still a small hearth of cancerous tissue composed of six or seven cones pressed together.

THROMBOSIS OF THE INTERNAL ILIAC VEIN DURING PREGNANCY.

BY F. C. GOLDSBOROUGH, M. D.,

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(From the Obstetrical Clinic.)

Thrombosis of the vessels of the lower extremities during pregnancy is of such infrequent occurrence and the statements concerning its etiology in the few cases reported in the literature are so scanty and unsatisfactory that it seems advisable to place every case of the kind upon record, particularly when definite statements can be made regarding the etiological factors concerned.

It is my intention in this paper to report a case of thrombosis of the left common iliac vein and its branches, which occurred in the obstetrical department of the Johns Hopkins Hospital, in the service of Prof. J. Whitridge Williams, to whom I am indebted for the privilege of this report.

After carefully reviewing the literature, I have been able to collect but ten cases of phlebitis occurring during pregnancy, though, unfortunately, the reports of three of them, Bradford, Commandeur and Dickinson, are lacking in many important details.

In the cases of Bonnet-Laborderie and Gripat the thrombosis occurred in both legs. In the former, the left internal saphenous vein was affected, while the location of the lesion in the right leg was not stated, the author designating the condition as spontaneous phlebitis. In the latter, the right femoral vein was thrombosed, but no mention was made as to which vessel was involved on the left side. The author ascribed the condition to toxemia of pregnancy, associated with chronic anæmia resulting from paludism.

Of the five cases in which only one leg was affected, the left femoral vein was involved in the patients of Brindeau, Audebert, Saint-Ange and Bacon, while in Beaudry's case the right saphenous vein was the seat of the lesion. In no instance was the etiology perfectly clear, although several of the authors did not hesitate to suggest a definite causative factor for individual cases. Thus, Brindeau supposed that his patient had suffered from an infectious process, such as la grippe or a gastro-intestinal toxemia during the seventh month of pregnancy, to which he believed the thrombosis and albuminuria which occurred in the following month could be attributed. Bacon's patient had complained of frequent and painful uterine contractions for ten days preceding the appearance of the thrombosis, and the author concluded that "the long-continued uterine contractions may have dislodged placental masses that formed rudimentary emboli, or perhaps altered the blood composition."

In connection with these data it is interesting to ascertain the effect of a thrombosis upon the course of the subsequent labor. No information upon this point is available in the reports of Bonnet-Laborderie and Dickinson. In two other cases the pregnancy terminated spontaneously at the fifth and eighth months, respectively, while the remaining patients went on to full term and were delivered normally and spontaneously. Moreover, it is interesting to note that in only two instances did the patients suffer from fever.

In all the cases in which it was mentioned, the treatment consisted in rest and immobilization of the affected part during the acute stages of the affection; which, as far as the reports show, led to the complete recovery of all the patients.

Our case occurred in a white woman, 29 years of age, who was admitted to the obstetrical department of the Johns Hopkins Hospital on Saturday, June 6, 1903 (Obst. No. 1499), complaining of constipation, nausea and vomiting and swelling of the left leg. Her family history was negative. The patient had always been healthy except for scarlet fever at 14

and diphtheria at 20 years of age. Menstruation first appeared when she was thirteen and a half years old, after which it recurred regularly and without any disagreeable symptoms; the last period having begun on the 10th of September, 1902.

The present pregnancy, which was the first one, had been practically normal until four days before admission to the hospital. There had been no nausea or vomiting, headache or visual disturbances, and the bowels had been regular until about a week before admission, though a slight leucorrheal discharge had occasionally been noted. The patient, who was employed in another hospital, had been able to attend to her usual duties until one week before admission. Up to that time she believed that no one had suspected her condition, which she successfully concealed by wearing a specially constructed corset, which enabled her so to compress her abdomen as to conceal its enlargement, simply giving the impression of being a well-developed woman with a broad waist. A week before entering the Johns Hopkins Hospital she was compelled to go to bed on account of marked œdema of her left leg. During this period the bowels did not move, and four days later she began to suffer from nausea and vomiting.

On admission the patient was found to be a large-framed woman with no puffiness about the face or eyelids. Nothing abnormal could be made out in the heart or lungs. On inspecting the abdomen, the uterus was seen to be deflected toward the left side, where it reached as high as the costal margin. The epigastrium and upper right abdominal quadrant were greatly distended, and coils of intestine could be clearly distinguished, which could be seen to be going through vigorous peristaltic movements. The stomach was greatly distended and occupied the epigastrium. The child was of moderate size and lay in the right occipito-iliac transverse position, with its head freely movable above the superior strait.

The left leg was enormously and symmetrically swollen from the toes to the groin. There was no increase in its surface temperature, nor was it painful on pressure. The skin was white and glistening, firm and tense, and pitted readily under the finger. In the fold of the groin there was an excoriation 5 cm. long by 5 mm. broad, apparently resulting from a blister; while in the region of the knee there were several blebs, which varied from 1 to 5 mm. in diameter. On careful palpation one could not detect thrombosed vessels either in the groin or at the location of the external saphenous vein. The pulse was 80 to the minute, well sustained, with moderate tension. The vessel walls were palpable. The urine was amber in color, with a specific gravity of 1020 and an acid reaction. Sugar and albumin were not present. On standing, a moderate amount of flocular sediment was deposited, which under the microscope showed only a few epithelial and pus cells.

The patient was put to bed and the leg wrapped in cotton and elevated. The bowels were moved by an oil enema and subsequently kept well open by the use of purgatives by the mouth, though these were only partially retained, and then only with the greatest difficulty. The nausea and vomiting, however, persisted during the succeeding 48 hours, and all means employed to check it were ineffectual, so that no nourishment was retained. In spite of her low pulse and the absence of increased temperature, the patient made the impression of being very ill, so that it was determined to induce labor in the hope of relieving her.

Accordingly, at 5 P. M., June 8, a Champetier de Ribes balloon was introduced into the uterus. Four hours later labor pains supervened, which were fairly effectual and recurred at short intervals. Unfortunately the balloon burst at 3 A. M. the next morning, though the pains continued several hours longer, when they completely disappeared. At 10 A. M. the temperature was 100° F. and the pulse quite rapid, while the patient appeared considerably worse than when the bag was first introduced. For this reason it was determined to deliver her at once rather than to complete the dilatation of the cervix with another balloon.

Examination under chloroform anæsthesia showed that the external os was soft and about 5 cm. in diameter, while the cervical canal was between 2 and 3 cm. long; the presenting part was still freely movable above the superior strait. The cervix was then dilated manually without great difficulty by the Harris method, after which the child was turned and extracted. The operation, however, was extremely difficult, as the uterus became tetanically contracted as soon as the hand was introduced into it, necessitating the use of considerable force in completing the version. Owing to the difficulty in extraction, the child was born dead, when it was found to be a well-formed female, 50.5 cm. long and weighing 3330 grammes. As the patient was much shocked by the operation and had bled very freely, the placenta was removed manually and a perineal laceration speedily repaired.

After being placed in bed, the patient responded fairly satisfactorily to stimulation and toward evening her condition seemed quite favorable. About midnight, however, the pulse became rapid and of poor quality, the patient became irrational and did not respond to stimulation; vomiting set in and death ensued at 3 A. M., 15 hours after delivery.

An autopsy was performed 8 hours after death by the resident pathologist, Dr. W. G. MacCallum, to whom I am indebted for the following notes: The body was that of a large, well-nourished white woman, rigor mortis present. The left leg was much enlarged and could be indented with the finger. On careful palpation a hard cylindrical mass could be felt in the inguinal region. On opening the abdomen no fresh adhesions were found in the peritoneal cavity, but many old adhesions were present about the uterus, and bound the left tube and ovary into a single mass. The stomach was much distended with gas. The pleural and pericardial cavities appeared normal and contained no excess of fluid. The pulmonary arteries were opened *in situ*, but no thrombi were found in them, nor in any of their minor branches.

On macroscopic examination, the heart, spleen, adrenals, pancreas, bladder, stomach and intestines appeared normal, while the liver and kidneys showed some evidences of degenerative changes. There was no consolidation of the lungs, which, however, were moist, purple in section, a good deal of

fluid and frothy blood exuding from the cut surface. The vessels were clear and normal; the bronchi were blood-stained and contained a little mucus.

Microscopical examination showed that all the organs were considerably congested. There was marked fragmentation of the myocardium. The lungs showed evidences of œdema. There was considerable degeneration of the liver cells with signs of chronic passive congestion. The renal epithelium was extensively degenerated, but particularly in the tubules.

The lumen of the left common iliac vein was completely occluded where it was crossed by the right common iliac artery. From this point, as far down as the dissection was carried, the vessel was filled by a thrombosed mass, which extended into the external iliac and from it into the femoral and saphenous veins. On the other hand, it stopped abruptly at the point of compression, above which the vessel was perfectly normal. In places the thrombus was of a pale color and showed definite lamellæ; elsewhere it was purplish black, but even here a lamellated structure was visible. The intima of the veins was destroyed, the thrombus being firmly adherent to the vessel wall.

Microscopic sections through the thrombosed vessel showed practically no change in its walls, except for the absence of the endothelial lining. There were no signs of marked inflammatory reaction, the entire lumen being merely filled by a blood clot which was firmly adherent to its wall.

Cultures taken from the heart's blood and the thrombus at the time of autopsy were absolutely negative; nor could the most thorough examination of appropriately stained hardened specimens reveal the presence of bacteria.

The comparison of the clinical history of this case with the autopsy findings would seem to leave no doubt as to the sequence of events, and apparently shows quite definitely the causative factor in the production of the thrombosis. The negative results of the cultures made from the heart's blood and from the thrombus at the time of autopsy, as well as the absence of bacteria in suitably stained sections through the thrombus, would appear to eliminate the possibility of a bacterial origin, and therefore force us to seek some other cause.

After carefully considering all the possibilities, it seems to us that this factor is to be found in the pressure which was brought to bear upon the retro-peritoneal structures by the corset which the patient wore to disguise her condition. As the uterus enlarged, it was forced with increasing intensity by the binder downward and backward against the bodies of the lumbar vertebræ and the structures in front of them. This naturally interfered with the return of the blood from the lower extremities, which was particularly marked at the point where the right common iliac artery crossed the left common iliac vein. As the pressure increased, the latter vessel became compressed between the artery in front of it and the vertebral column behind it, so that eventually its lumen became completely obliterated, when effectual stagnation was brought about. Subsequently coagulation occurred and the thrombosis resulted with the effects already mentioned.

It would, therefore, seem more than probable, in view of the mechanical conditions present and the negative results of bacterial examination, that we have to deal in this case with thrombosis resulting from pressure. Such an occurrence is rare under any circumstances, and as far as I have been able to learn has not as yet been described as a causative factor in a thrombosis occurring during pregnancy.

Case.	Age.	Para.	Period of Gest.	Fever.	Affected Part.	Effect on Labor	Etiology.	Reported by.
1	33	3d p.	8th mo.	—	Lt. femoral vein.	None.	Intercurrent infection.	Brindeau.
2	27	1st p.	8th mo.	—	Lt. internal saph. vein right leg.	None.	Spontaneous phlebitis.	Bonnet-Laborderie.
3	28	2nd preg.	7½ mo.	?	Rt. internal saph. vein.	None.	?	Beaudry.
4	?	?	Term	?	Rt. leg and thigh.	Very incomplete account.		Bradford.
5	32	7th preg.	End of 3rd mo.	—	Rt. femoral and left leg.	At 8th mo. child stillborn.	Anæmia and albuminuria.	Gripat.
6	30	1st p.	8th mo.	?	Left leg and thigh.	?	?	Dickinson.
7	40	2nd preg.	6½ mo.	?	Left femoral vein.	None.	?	Audebert.
8	?	?	1 mo.	—	Left femoral vein.	Miscarriage at 5th mo.	?	Saint-Ange.
9	?	3rd preg.	5th mo.	—	Rt. leg.	None.	?	Commandeur.
10	23	1st p.	8th mo.	+	Left femoral vein.	None.	See abstract.	Bacon.
11	29	1st p.	Term	+	Left common iliac vein.	Operative delivery.	Pressure thrombosis.	F. C. Goldsborough.

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CHANGES IN THE NERVOUS SYSTEM AFTER PARATHYROIDECTOMY.

By Colin K. Russell, M. D. (*McGill*).

It has been shown by Gley, Vassale and Generali and others that dogs after the extirpation of the parathyroid glands die usually in the course of a few days of a generalized tetany. Vassale and Donaggio made a series of examinations of the spinal cord of seven of such dogs. In six of these after the cord had been kept in Müller's fluid for 3-5 months, they found a macroscopical alteration thought to be a degeneration in the crossed pyramidal tracts identical in situation with that following ablation of the motor cortex, and also a similar change in the posterior tracts. This degeneration so clearly visible to the naked eye could not be demonstrated microscopically with Marchi's stain or with the Weigert-Pal method. With a 1 per cent solution of nigrosin they were able to distinguish a swelling and granular appearance of the axis cylinders, and the myeline sheath showed atrophy and did not take the stain well. They did not examine the cortex and left the question open whether this was a primary degeneration of these tracts or whether it was secondary to an atrophy of the respective cortical ganglion cells.

Through the kindness of Dr. W. G. MacCallum, I have been able to examine the brain and cortex in several of the animals of his series of experiments which he published lately and which he is still carrying on, with the object of determining if this degeneration were primary in the cortical cells.

The method used was as follows:

The motor cortex, medulla, and a section of the cord were hardened in 95 per cent alcohol for three days. They were then imbedded in paraffin and cut in sections 10 μ thick.

The sections were stained with Nissl's methylene blue, the temperature being very gradually raised until steam was given off. They were then decolorized with aniline oil 10 per cent in 95 per cent alcohol, until the stain ceased to be given off. Oil of cajuput followed by xylol and mounted in neutral balsam.

A control was obtained by killing an animal very quickly by opening both carotids and crural arteries.

The following is the synopsis of the histories of the experiments taken from Dr. MacCallum's notes with the histological findings:

Case 1.—Dog 128. Four parathyroids removed—violent tetany two days later. Thyroids then removed under ether. Violent exacerbations of tetany and death about 60 hours after first operation.

Sections made through the motor cortex show some indefiniteness in the outline of the pyramidal cells. The processes are long. In a great many cases the cells are surrounded by numerous neuroglia cells.

The cell itself shows marked chromatolysis, staining much more deeply and diffusely about the nucleus, owing to the chromophile granules which ordinarily stain distinctly having become broken up and exceedingly fine. As we approach the processes, the chromophile granules become more sparsely distributed although they extend for a very considerable distance and are frequently so placed along the margin as to give the process a roughened appearance.

The nucleus is centrally placed and as a rule has a fairly sharp outline. It takes a faint bluish tinge.

The nucleolus stains deeply.

The cord fixed in Müller's fluid shows macroscopically on cross sections pale areas confined to the crossed pyramidal tract. Although this was stained with the Weigert-Pal, Marchi and Stroebe methods and also with nigrosin 1 per cent, it has been found impossible to demonstrate any degenerative changes microscopically. This same difficulty has been found by Vassale, in his experiments.

Cutting longitudinal sections through these tracts was also tried to see if any swelling of the axis cylinders could be demonstrated but I could not satisfy myself that this was present.

Case 2.—Dog 133. Two parathyroids on right side and left lobe of thyroid together with parathyroids removed, followed by sickness and depression for 26 days before the onset of a moderate grade of tetany. Dog killed in order that blood might be transfused into another dog, 27 days after first operation.

In this dog there were found on examination scattered through the cortex and often side by side with well preserved pyramidal cells, numerous shrunken twisted pyramidal cells with tortuous processes; these cells may be very much diminished in size and are sometimes extremely narrow and dense looking. In the more intensely affected examples the chromophile granules are no longer to be made out at all, but the whole protoplasm takes a dense blue stain sometimes so intense as to completely hide the nucleus. The nucleus itself is shrunken and deeply stained. The nucleolus is frequently no longer visible. Neuroglia cells accumulated about these nerve cells seem very abundant.

In the cord there are also two conditions of the cell to be seen often side by side. In the one the Nissl's bodies are distinct and evenly scattered through the cell. They are large and irregularly shaped and extend a short distance down the processes; here they are long with the long axis parallel to the axis of the process. The nucleus and nucleolus are centrally placed, the nucleus takes a faint bluish tinge, the nucleolus staining deeply. These are practicaly normal cells.

In the second type there is a slight degree of chromatolysis especially marked in the body of the cell in the neighborhood of the nucleus. The nucleus and nucleolus are unchanged.

In the cord fixed in Müller's fluid there was no degeneration of the crossed pyramidal tract made out either macroscopically or microscopically.

Case 3.—Dog 138. Four parathyroids removed. Violent tetany two days later. Both thyroids removed with no effect. Tetany increased; bled to death under ether two days after primary operation.

The pyramidal cells show a degree of chromatolysis similar to Case No. 1. There are practically none of the shrivelled cells that are seen in Case 2, although one or two are visible.

In the medulla stained with Nissl's method, there is a slighter degree of chromatolysis than is seen in the cortex. The chromophile granules have a distinctly finer appearance than is seen in the control specimen.

The cord shows nothing abnormal except that the processes can be followed for a longer distance than they can in the control specimen.

In the cord fixed in Müller's fluid, no macroscopical degeneration can be made out nor could any be demonstrated microscopically.

CASE 4.—Dog 139. Four parathyroids removed, followed by marked depression, very severe tetanic convulsions on 7th day and death.

Pyramidal cells of cortex show a chromatolysis similar to Case 1. There are a few shrivelled, distorted cells such as are seen in Case 2, but these are not at all numerous.

In the cord, while some of the ganglion cells are perfectly normal, most show a greater or less degree of chromatolysis.

The cord fixed in Müller's fluid shows no macroscopical degeneration of the crossed pyramidal tract; and in longitudinal sections through this tract I could make out no swelling of the axis cylinders.

CASE 5.—Dog 141. Left motor cortex removed, followed by paresis of right side. 10 days later three parathyroids were removed from left side and the right thyroid lobe together with its parathyroids. Seven days later violent tetany, more marked on left side; noticeable on right side also. Died under ether.

The cortical pyramidal cells from the right side show a degree of chromatolysis similar to Cases 1, 3 and 4.

In the cord the cells seem perfectly normal.

There is a marked degeneration in the crossed pyramidal tract on the right side of the cord. Left side is normal.

CASE 6.—Dog 148. Two parathyroids removed from right side and the thyroid lobe together with the parathyroids on left side. Tetany quite violent on the second day following. Intermittent tetany during eleven days after the operation at the end of which the dog was found dead.

In the cortex the pyramidal cells have a rather indefinite outline. There is also a marked chromatolysis, not confined as a rule to the neighborhood of the nucleus but general. Some of the cells are quite broken up.

There are very few shrivelled, distorted cells as described in Case 2. In a great many cases numerous neuroglia cells are seen surrounding the ganglion cells. The cell processes may be followed for some distance as a rule.

The nucleus in a great many cases has disappeared, in some others it is somewhat swollen and may be dislocated more or less to one side of the cell. Nucleolus stains darkly.

In the cord the cells show a fairly well marked chromatolysis. The processes can be followed for some distance from the cell. In some cases the cell is more or less surrounded by neuroglia cells. In some vessels in the posterior horn there is a marked outwandering of leucocytes and many of the cells in the immediate neighborhood are shrunken and stain very deeply and diffusely.

CASE 7.—Dog 132. Two parathyroids removed from right side. Whole thyroid lobe with its parathyroids removed from left side. Great depression. Intraperitoneal injection of two thyroid glands. Cachexia and emaciation. Death 15 days after primary operation.

In the cortex the pyramidal cells have a diffuse finely granular appearance, showing marked general chromatolysis. In a few, the nucleus is somewhat laterally situated. Processes are fairly long.

In the cord, the ganglion cells show a marked chromatolysis especially about the nucleus, while near the periphery and at the beginning of the processes a few irregularly shaped Nissl bodies can be made out. A few stain diffusely throughout; no chromophilic bodies can be made out. In one of these the nucleus is protruded from the cell entirely; in others it is somewhat displaced laterally. Many cells are surrounded by unusually abundant neuroglia cells.

From the study of these brains it seems evident that when after parathyroidectomy the dogs succumb with symptoms of tetany, etc., there are to be found fairly uniform, if slight alterations in the cells of the central nervous system. These alterations consist in:

1. Chromatolysis in which the chromophile granules especially in the immediate neighborhood of the nucleus become reduced to such a fine state of division as to give a diffuse blue stain with Nissl's method. In the cases in which the tetany is of longer duration, the change may be such that isolated chromophile bodies are no longer to be distinguished in the cell. Associated with this alteration there may be a dislocation of the nucleus or even in extreme cases its expulsion from the cell. Sometimes it is possible in these cases to trace the protoplasmic processes to a great distance from the cell.

2. In most severe cases there is in many of the large pyramidal cells a change which leads to their great shrinkage and distortion, the cell protoplasm becoming so densely stained as to hide the nucleus.

3. The small neuroglia cells, of which one or two are usually associated with the pyramidal cells, may become more numerous so that each nerve cell is surrounded by a group of them. This is evidently the appearance described by Quervain and others as due to an accumulation of leucocytes in the spaces about the nerve cells. The function of these neuroglia cells is not understood, but it is thought by many that they may be of a phagocytic nature.

In the medulla and cord the alterations are similar, although far less intense than in the cortex.

Since the general conditions of life of these dogs were the normal ones and no pathological alteration was observable in the other organs, it is thought justifiable to ascribe these changes to the influence of the toxin which appears in the body after parathyroidectomy.

The macroscopic change which Vassale and Donaggio observed in the spinal cord of parathyroidectomized animals after protracted treatment of the tissue with chrome salts is described by them as an alteration not recognizable by the methods of Marchi or Weigert, although by the use of nigrosin they were able to discern a swelling of the axis cylinders and an atrophy of the medullary sheaths in the pyramidal and dorsal tracts. In only one case of this series was such a change evident, possibly because in all the others the tissue had not lain for 3-5 months, as Vassale recommends.

In conclusion, therefore, it seems that we have in the cortical cells anatomical alterations which, although very slight, are still sufficiently well marked to afford a basis for the functional changes which led to the tetany. It seems probable further that the degenerative changes in the pyramidal tract of the spinal cord observed in one case and noted so often by Vassale may represent the analogous condition of the axis cylinder processes of these same cells. Probably in time this alteration of the axis cylinder processes which is possibly secondary to the change in the nerve cell, would be associated with alterations in the myelin sheath recognizable by the usual methods.

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THE RELATION BETWEEN CARCINOMA CERVICIS UTERI AND THE RECTUM AND ITS SIGNIFICANCE IN THE MORE RADICAL OPERATIONS FOR THAT DISEASE.

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The invasion of carcinoma cervicis uteri into the surrounding tissue manifests itself in the large percentage of cases admitted to this hospital in which the disease has extended so far that palliative treatment alone is indicated and also in the still larger percentage of cases in which the disease returns after operation, showing that at the time of the operation the growth had already invaded the surrounding tissue and that hysterectomy alone seldom cures this disease. In October, 1902, our cases were reviewed, and at that time in over three-fifths of the patients admitted to the hospital the growth had extended beyond operative treatment. Of 143 patients in which hysterectomy had been done, 21 died as a result of the operation, giving a primary mortality of 14.6 per cent. Three years or more had elapsed since the operation in 69 of the cases which we had been able to follow, and at the end of that time 20 were living, but 6 of these later had recurrences, thus giving a percentage of recurrences after three years and more of 78.2 per cent. When we considered those cases in which five years or longer had elapsed since operation we found that there were 49 whom we had been able to follow, and of this number the growth had returned in 43, or 87.7 per cent. We realize, however, that five years is not long enough, for two of our patients had died at the end of six and seven years from general carcinosis without a return in the vaginal vault, and a third was living, with a small growth in the vaginal scar, five and a half years after operation, there having been symptoms referable to it for only two months. We reviewed our cases again in May of this year and found that after three years or more, in 76.5 per cent the growth returned in 94 cases whom we were able to hear from, and that after five years or more the percentage of recurrence was 79.1 per cent in 67 cases heard from. This improvement over the review made in October, 1902, can be explained in two ways: first, that physicians and patients realize more and more the importance of an early diagnosis, and secondly, the operations have become more radical each year.

The importance of a more radical operation in these cases has been emphasized in previous publications[1] and also the relation between the growth and the ureters[1,2,3] and bladder,[2] as well as the efficiency[3] of the blood supply of the ureter and also the complications[1] arising from freeing the ureter from its sheath and injury to its blood supply. The dangers[4] of ascending renal infection from post-operative cystitis have also been considered and a possible way of controlling the bladder infection has been suggested.

The relation between the rectum and carcinoma cervicis uteri should be considered, for in many instances it has a very important bearing in these operations. This relation manifests itself clinically in the posterior extension of the disease, thus involving the anterior wall of the rectum and with the necrosis of the cancerous tissue a recto-vaginal fistula is formed. Another manifestation of this relation is injury to the rectum, which may occur in hysterectomy for the disease.

The object of this paper is to see what may be learned from anatomical and pathological studies as well as clinical experience in regard to the relation between cancer of the cervix and the rectum, and if these results have any bearing on the more radical operations for this disease.

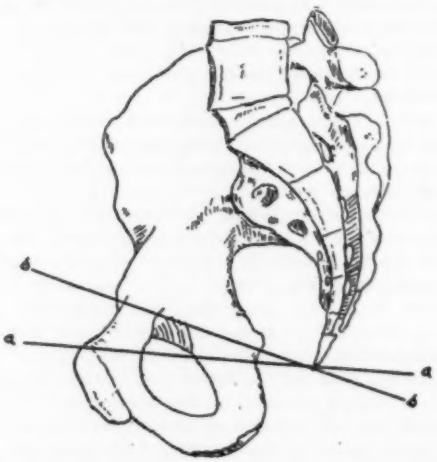

Fig. I.—View of the Inside of the Right Half of the Pelvis of a Woman Standing, × $\frac{1}{10}$. (Spalteholz).

a-a Represents a horizontal plane passed through the body from the top of the symphysis.

b-b Represents the plane at which the section shown in Fig. II was cut

Anatomical Relations between the Uterus and Rectum under Normal Conditions.

While much may be learned about the relation between the uterus and rectum from dissections and a study of the conditions found at operations, nevertheless, a study of cross sections of the pelvis probably indicates this relation more clearly than any other method. Fig. II is a drawing made from a cross section of the pelvis of a woman 30 (?) years old. The section is indicated by the line *b-b*, Fig. I, and is higher on the right than on the left side. Fig. III is a reconstruction made from the sections made in this case, and line *V* indicates the section from which Fig. II was drawn. In this case the rectum was situated in the left side of the pelvis and one can see that the relation between the two is dependent on the position of the uterus in the pelvis and that in this instance nearly

the entire uterus is situated to the right of the rectum. As the uterus under normal conditions is a relatively freely movable organ, it adapts itself to the space in the pelvis in which there

each ureter, as far as the fixed structures are concerned, as, for instance, the walls of the pelvis in Fig. II, is the same for each, but that their relation to such structures as the uterus

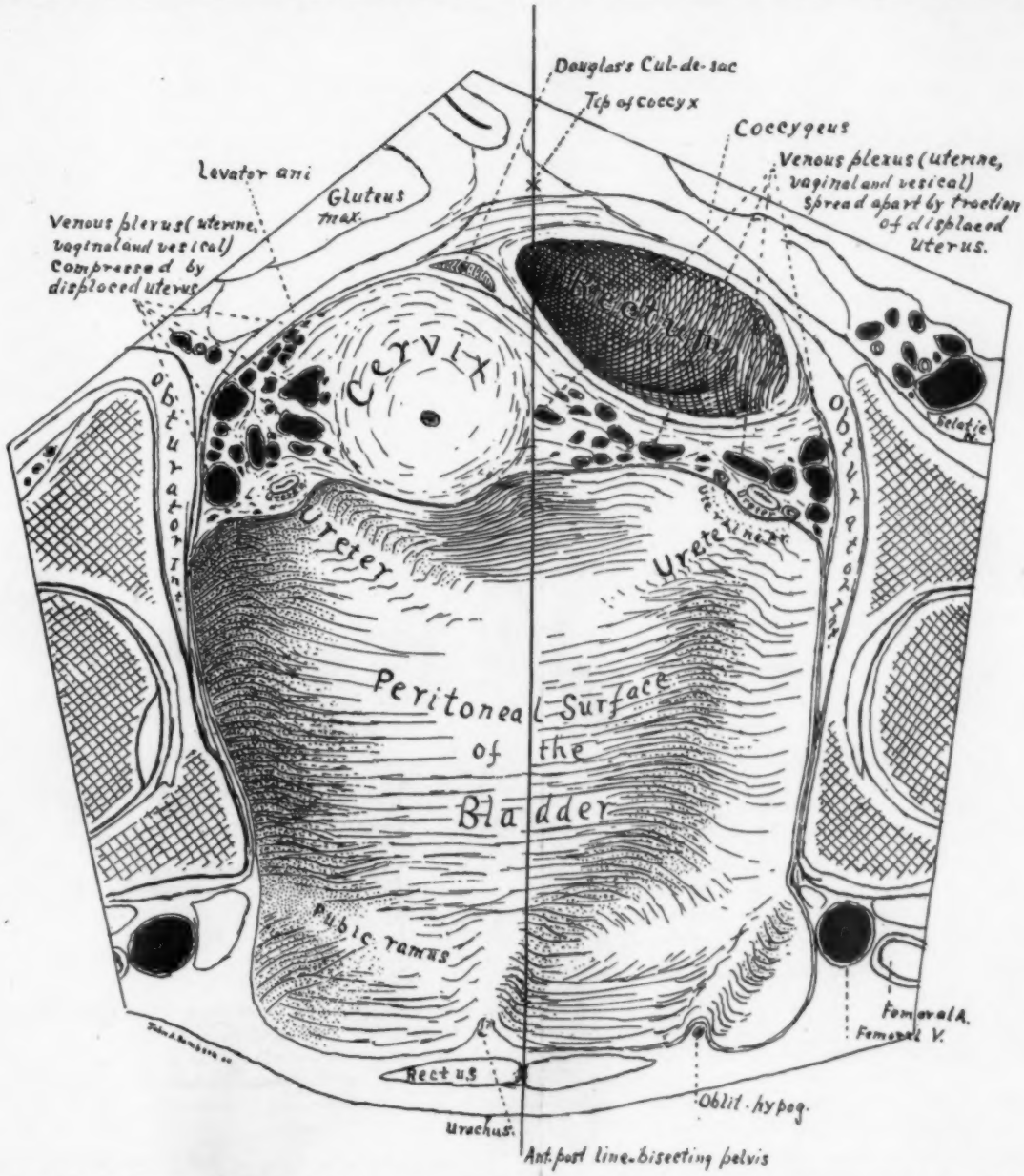

FIG. II.—CROSS SECTION OF THE PELVIS OF A MULTIPARA 30 (?) YEARS OLD, × 1. SECTION REPRESENTED BY THE LINE b-b, FIG. I, AND V, FIG. V.

Uterus is in retroposition, adherent, and in the right side of the pelvis.

Notice what an important factor the position of the cervix in the pelvis is in determining what tissue may be invaded by an extension of carcinoma cervicis uteri. The relation of the uterus to other structures in the pelvis is dependent on the position of the uterus in the pelvis.

is the most room and its position in the pelvis is in a measure determined by the position and size of the rectum. By referring to Figs. II and III again one may see that the course of

and rectum is dependent on the position of the uterus and rectum in the pelvis. So the relation between the uterus and the rectum is dependent on the position of the uterus in the

pelvis whether in the right or left lateral position, and also whether forward or in retroposition and whether high in the pelvis or in descensus. A study of sagittal sections of the pelvis also aids in understanding the relation between the two organs. A line bisecting the uterus shown in Fig. III would cut the rectum only below the cervix, while a line bisecting the pelvis would bisect the rectum at the level of the top of the uterus, but at the level of the internal uterine os it would almost serve as the boundary line between the uterus, which is in the right side of the pelvis, and the rectal pouch, which is situated in the left side of the pelvis. The posterior surface of the uterus is covered by peritoneum and the reflexion of this peritoneum over upon the uterus forms the bottom of the so-called cul-de-sac of Douglas. The bottom of this cul-de-sac is situated at a lower level than the lower portion of the cervix when the uterus is in its normal position, and as is well known the peritoneal cavity can easily be opened by an incision through the vaginal vault posterior to the cervix (see Fig. IV). While there is a relatively broad attachment between the bladder and cervix anteriorly, the cervix is separated from the rectum by the cul-de-sac with its uterine and rectal peritoneal lining and in descensus the posterior vaginal wall is interposed between the two organs. In addition, there is adipose tissue between the anterior rectal wall and the vagina and rectal peritoneal covering of the cul-de-sac. The amount of this adipose tissue varies in different cases, as can be seen by comparing Figs. II and IV.

A result of these anatomical studies shows that a direct invasion of the rectum by carcinoma cervicis uteri must extend either through the cul-de-sac, which may have become obliterated by adhesions, or indirectly through the vaginal wall, which may have become involved by the growth, or else the parametrium of one side, which may be situated directly in front of the rectum, as the left parametrium is situated in Fig. II.

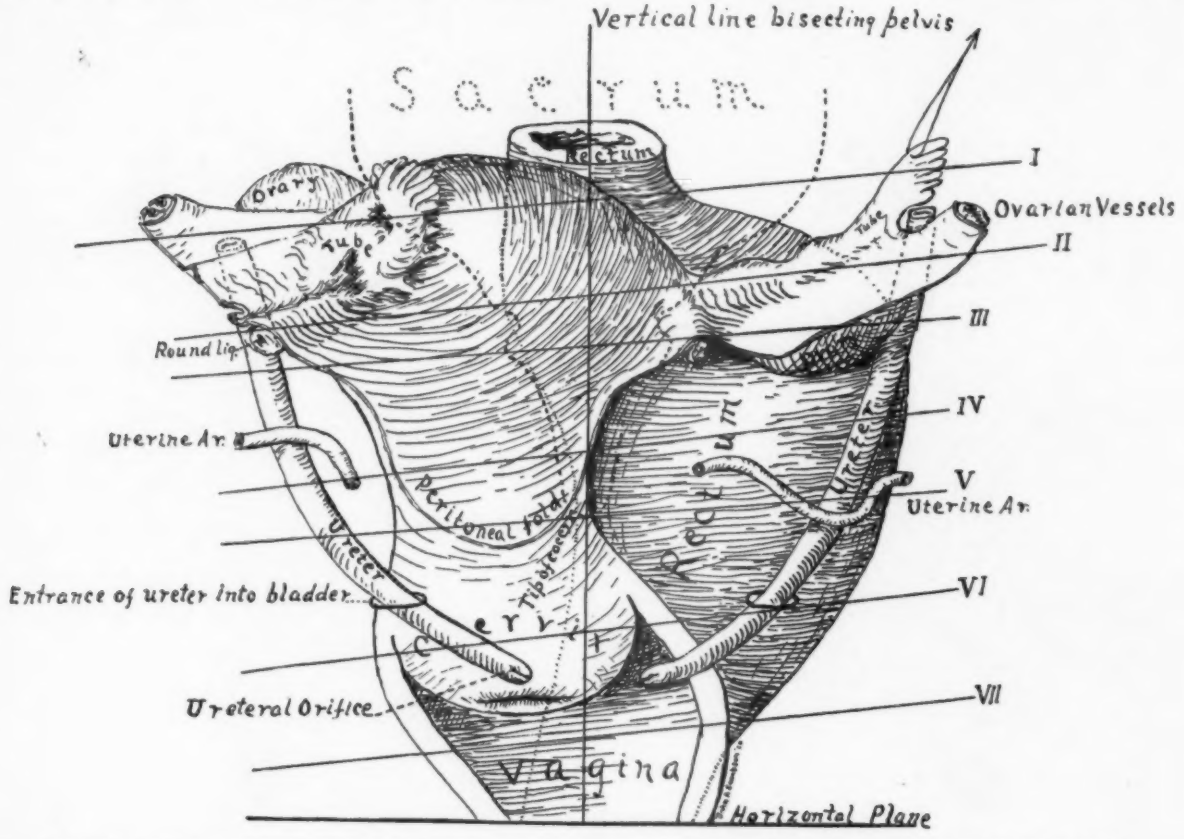

FIG. III.—RECONSTRUCTION SHOWING THE RELATION BETWEEN THE CERVIX AND OTHER PELVIC STRUCTURES, FROM CROSS SECTIONS OF THE PELVIS OF A MULTIPARA 30 (?) YEARS OLD, × 1.

Reconstruction from cross sections of the pelvis of a woman, with the uterus in retroposition, adherent, and in the right side of the pelvis. Fig. II represents one of the cross sections. One may see what an important factor the position of the uterus in the pelvis is, in determining the relation between that organ and other pelvic structures, and what structures are likely to be first involved in a direct extension of the growth.

RELATION BETWEEN CARCINOMA CERVICIS UTERI AND THE RECTUM.

It is difficult to understand why the growth in one case may extend in a certain direction, while in another case the direc-

tion may be different. In one specimen the growth may be confined to the anterior portion of the cervix, the bladder soon becoming involved; on the other hand, in another case the posterior portion of the cervix may be involved and the rectum may soon become invaded. There seem to be as many types of the direction in which the growth may extend as there are possibilities. We are unable to determine why the direction of the invasion of the growth may vary in different cases. The most important factor, aside from the direction of the growth, in determining the parts involved by the extension of the growth, *is the position of the uterus in the pelvis.* By referring to Figs. II and III, where the uterus is in adherent retroposition in the right side of the pelvis, one can see how easily the right ureter could become involved by the growth, while the growth would have to be very extensive in order to com-

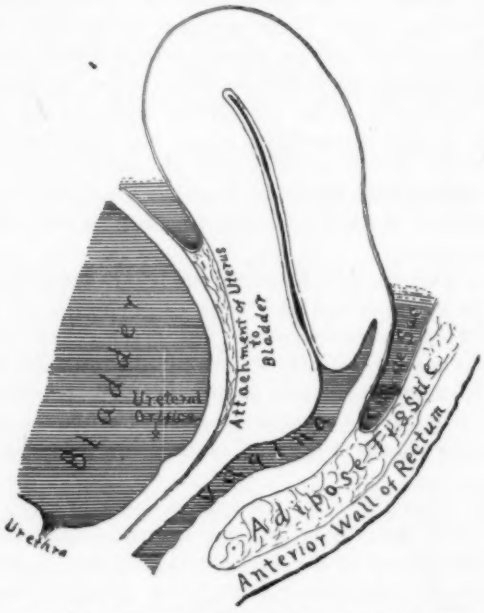

FIG. IV.—SAGITTAL SECTION SHOWING THE RELATION BETWEEN THE UTERUS AND RECTUM, × 1.

From autopsy specimen. Pelvic contents were removed in one mass and then hardened in formalin. Notice the large bladder attachment and that the cervix is separated from the rectum by the cul-de-sac. Carcinoma cervicis uteri must reach the rectum either through the obliterated cul-de-sac or through the vagina, which may become involved (see Figs. V and VI).

press the left ureter. The rectum could be involved by the extension of the growth to the left, either through the cervix or indirectly through the vagina or left parametrium. On the other hand, when the uterus is in the left lateral portion of the pelvis or in anteposition, its relation to surrounding parts has changed, and so the portions of the pelvis invaded may be different.

In Fig. V is represented a sagittal section of a specimen (Gyn. Path. No. 7419) in which the growth in its posterior extension has obliterated the cul-de-sac and invaded the tissue to the right of and also anterior to the rectum. The uterus was in retroposition and in the right side of the pelvis, as in Figs. II and III, so that the posterior extension of the disease for the most part after obliterating the cul-de-sac invaded the adipose tissue lateral to the rectum.

Fig. VI (Gyn. Path. No. 7370) represents how the vagina may become involved and the growth in its posterior extension may invade the rectum. The vagina is separated from the rectum by a layer of adipose and fibrous tissue and the thickness of this layer varies in different cases, depending on the amount of adipose tissue. In some cases it is very thin, while in other cases it is quite thick, as in the specimen shown in Fig. IV. When the growth has invaded the vaginal wall there is very little to hinder its invasion of the wall of the rectum.

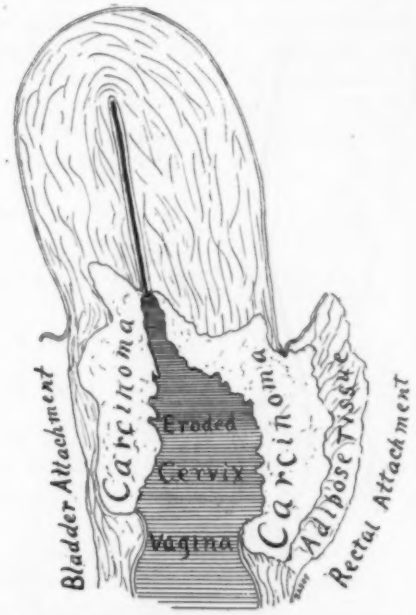

FIG. V.—SAGITTAL SECTION OF CANCEROUS UTERUS, SHOWING HOW THE GROWTH MAY EXTEND TOWARDS THE RECTUM THROUGH THE OBLITERATED CUL-DE-SAC, × 1. GYN. NO. 11192, GYN. PATH. NO. 7419.

The growth has involved both the anterior and posterior walls of the cervix and in its extension posteriorly has obliterated the cul-de-sac and invaded the adipose tissue anterior and lateral to the rectum.

EFFECT OF THE MORE RADICAL OPERATION FOR CARCINOMA CERVICIS UTERI ON THE RECTUM.

In removing the uterus with the upper portion of the vagina, the anterior wall of the rectum is exposed, the amount of surface varying with the length of the vagina removed. Ordinarily the rectum is not injured by this; occasionally it is torn or a hole is cut into it by scissors or knife, but usually the vagina may be separated from the rectum through the adipose tissue between the two parts without inflicting any injury upon the rectum.

Recently I removed the uterus with pelvic lymphatics from a patient (Gyn. No. 11192) in whom the growth had extended

posteriorly, obliterating the cul-de-sac as high up as the level of the internal os (see Fig. V). The uterus was in retroposition in the right lateral part of the pelvis, the rectum being in the left lateral portion of the pelvis. The growth in its posterior extension had invaded the adipose tissue lateral to the rectum and in order to obtain a wide excision of the growth the adipose tissue about the wall of the rectum near the growth was removed, together with the uterus. The result of the above was that the right side of the wall of the rectum was exposed in places injuring its outer muscular coat. The convalescence of the patient was uneventful until

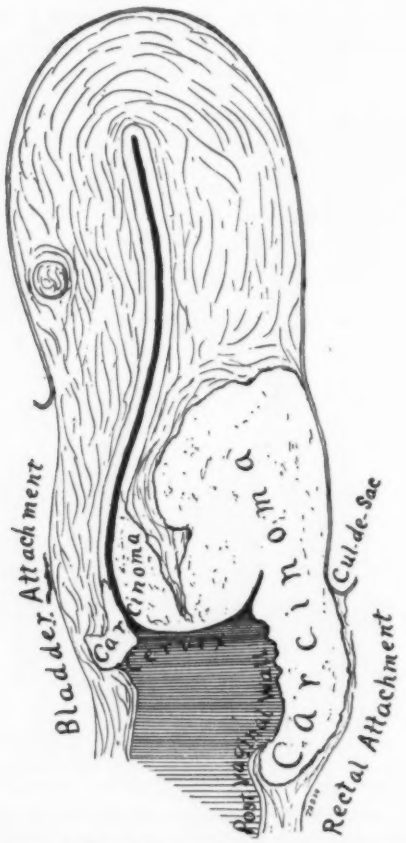

FIG. VI.—SAGITTAL SECTION OF CANCEROUS UTERUS, SHOWING HOW THE GROWTH MAY EXTEND TOWARDS THE RECTUM THROUGH THE POSTERIOR VAGINAL WALL, WHICH IS INVOLVED BY THE GROWTH, × 1. GYN. No. 11134, GYN. PATH. No. 7370.

The growth is restricted almost entirely to the posterior wall of the cervix. The cul-de-sac is intact, but the growth has extended out to the peritoneum, covering the anterior surface of the cul-de-sac. This drawing shows how the rectum may become invaded by the growth, which has involved the posterior vaginal wall.

the sixth day. The gauze drains, two in number, which extended from each side of the pelvis out through the vagina, had been started on the third day and completely removed on the fourth and replaced by fresh ones. On the morning of the sixth day the patient's temperature rose to 103°, but there were no subjective symptoms. The patient was placed in the elevated Sims position and the vagina exposed by a Sims speculum. On removing the gauze drains in the right side an opening about 1 cm in long diameter was seen in the right side of the rectal wall, from which there was a discharge of fecal matter. At the present time, May 4, the opening still exists, and unless it heals spontaneously an attempt will be made to close it.

BEARING OF THE ABOVE ON THE MORE RADICAL OPERATIONS FOR CARCINOMA CERVICIS UTERI.

A wide excision of the primary growth is most important in all forms of cancer and especially so in cancer of the cervix, for it soon invades the surrounding parts. While one wishes to avoid injury to the rectum, the first requisite is to remove the growth. It is most important to determine before operating the position of the uterus in the pelvis and its relation to surrounding parts. If the cervix is in the right side of the pelvis and fixed, and the rectum is situated to the left, one may see how easily the rectum could be involved by the extension of the growth either through the cervix to the left or through the left parametrium, which may have become involved by the growth (see Fig. II). By making a careful bimanual examination before the operation a definite plan may be formulated, and one may know just where a wide excision is needed most.

A very good plan is to insert a rectal tube in the rectum just before the operation and let it remain there during the operation. This serves two purposes: first, it gets rid of any fecal matter or gases which may be present and keeps the rectum empty during the operation; second, it is easily palpated during the operation and serves as a means of locating the rectum, in the same manner as the renal catheter does the catheterized ureter.

At the close of the operation the peritoneum which is reflected from the rectum over the bottom of the cul-de-sac should be sutured to the posterior vaginal wall in order to cover the raw area thus exposed. The operation[*] has been described fully in a previous publication.

CONCLUSIONS.

1. The relation between carcinoma cervicis uteri and the rectum may manifest itself in the recto-vaginal fistulæ which result from a necrosis of the growth which has involved the rectum in the posterior extension of the disease, and also in accidental injuries to the rectum occurring during hysterectomy for the disease.

2. The relation between the uterus and the rectum varies under different conditions and is dependent on the position of the uterus in the pelvis, whether in normal anteposition or retroposition, and especially the left and right lateral positions of the uterus. Descensus of the uterus also changes the relation between the two organs. The position of the uterus in the pelvis is a most important factor in determining what surrounding tissue may be invaded in the extension of the growth from the cervix.

3. The rectum may be invaded by a direct extension of the growth either through the cul-de-sac, the two surfaces of which have become adherent, or the posterior vaginal wall may become involved and the rectum secondarily invaded from the vagina, or in the lateral positions of the uterus the growth may extend across the obliterated cul-de-sac from the parametrium which lies in front of the rectum and which may have been invaded by the growth.

4. The first demand in the more radical operations for carcinoma is a wide excision of the primary growth, and portions of the rectal wall may be sacrificed and repaired if involved by the growth.

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8. ——— The Relation between Carcinoma Cervicis Uteri and the Bladder, and Its Significance in the More Radical Operations for that Disease. Johns Hopkins Hospital Bulletin, 1904, XV, 156-162.

OBSERVATIONS ON A STUDY OF THE SUBCLAVIAN ARTERY IN MAN.[1]

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The work on which these observations are based was undertaken at the suggestion of Dr. Harrison and carried out under the direction of Dr. Mall, in the anatomical laboratory of the Johns Hopkins University. The dissections were made by the students working in anatomy, and some of the drawings were made by them, but nearly all of the drawings were made by myself on Bardeen's Outline Record Charts.[2] One hundred and twenty-nine dissections of the subclavian artery were recorded, but fourteen of these were so incomplete as to be of no service in summarizing the work. Eighty per cent of the dissections were made on negro subjects. The artery was found to be divided naturally into five types, depending upon the origin of the large branches. The distribution of these branches was practically the same in all cases.

Type I was found in thirty per cent of the cases, and showed the internal mammary artery, rising from the first part of the subclavian, the vertebral rising from the first part of the subclavian, and the inferior thyroid and supra-scapular arteries rising from a common trunk which came off from the first part of the subclavian artery; also, the costo-cervical trunk arose from the second part of the subclavian artery, and so did the transverse cervical artery. This type was present on the right side of the body in twenty-two per cent of the subjects and on the left side of the body in eight per cent.

Type II was found in twenty-seven per cent of the cases, and showed the same origin for the vertebral and internal mammary arteries as Type I. The inferior thyroid, supra-scapular and transverse cervical arteries rose from a common trunk which came off from the first part of the subclavian artery. This is the thyroid axis as usually given. The costo-cervical trunk arose from the first part of the subclavian artery. This type of the artery was found on the left side of the body in twenty-two per cent of the subjects, and on the right side of the body in five per cent. In the three remaining types the vertebral and internal mammary arteries and the costo-cervical trunk arose from the first part of the subclavian artery as in Type II.

Type III was found in twenty-two per cent of the cases. In this type the inferior thyroid artery arose from the first part of the subclavian artery, the transverse cervical arose from the second part, and the supra-scapular from the third part. This was the most irregular of all the types. The supra-scapular artery arose from the axillary artery eight or nine times.

Type IV was found in twelve per cent of the cases. In

[1] Abstract of a paper read before the Johns Hopkins Hospital Medical Society, March 21, 1904.

[2] A complete study of the subclavian artery will soon be published in the American Journal of Anatomy.

this type the inferior thyroid artery arose from the first part of the subclavian artery. A trunk arose from the inferior thyroid artery and divided near the outer side of the neck into supra-scapular and transverse cervical arteries.

Type V was found in ten per cent of the cases. The inferior thyroid and transverse cervical arteries arose by a common trunk from the first part of the subclavian artery in this type. The supra-scapular artery arose from the internal mammary artery about two inches below the origin of the latter, and passed above the first rib, and anterior to the scalenus auticus muscle to its normal distribution. Arthur Thomson[3] tabulates five hundred and forty-four dissections of the subclavian artery. Classifying these in the same manner as our own cases, we get the five types with percentages as follows: Type I, forty-four per cent; Type II, forty-one per cent; Type III, seven per cent; Type IV, six and one-half per cent; Type V, one and one-half per cent.

Four anomalies were encountered frequently in the course of this work, and they are given in detail below because they may be important from a practical point of view. A "lateral thoracic artery" was found five times in twenty-eight subjects where the internal mammary artery was worked out in full. Many of the subjects were dissected after autopsies had been held, and in these the internal mammary artery had been destroyed, hence, the small number obtained. This "lateral thoracic artery" was as large as the internal mammary artery and arose from the latter beneath the first rib, and passed between the ribs and pleura to the diaphragm, sometimes ending about the fourth rib, and sending branches into each intercostal space, its distribution being similar to the internal mammary artery. This anomaly may be of interest clinically in cases of fractured ribs, in resection of ribs or in tapping the pleural cavity. From the position of this artery the indication would point to some posterior part of the thorax as the place of election for entering the pleural cavity with a trochar, rather than going in anteriorly about the sixth rib.

The second anomaly is Type V, which was found twelve times in one hundred and fifteen cases. Quain[4] found it present four times in two hundred and sixty-four cases (two per cent), and Arthur Thomson found it nine times in five hundred and forty-four cases (one and one-half per cent). This anomaly should be borne in mind when doing a complete breast operation, or in any operation near the sternal end of the clavicle, or the first rib.

The third anomaly is the middle thyroid artery or "arteria thyroida ima." This was found three times coming from the innominate artery, and, passing to the median line, it supplied the lower lobes of the thyroid gland and the isthmus. Wenzel Gruber[5] records one hundred and twenty-five anomalies of this kind, and concludes that the artery rises most frequently from the innominate artery, but also comes from the aorta and the common carotid artery not infrequently. He found it sixteen times in one hundred consecutive dissections. The anomaly should be considered in doing a tracheotomy, in operations on the thyroid gland, and in operations about the manubrium.

The fourth anomaly is the right subclavian artery coming from the distal part of the aortic arch, and passing between the œsophagus and the vertebral column at the third or fourth vertebra, finally going to its normal place above the first rib on the right side. Associated with this anomaly the two carotids arose together as the first branch of the aorta and the left subclavian arose as the second. Beyond this the right subclavian artery arose. The right recurrent laryngeal nerve did not form a loop around the subclavian artery, but passed directly to its normal distribution. This anomaly should have clinical consideration in relation to aneurism, especially with associated "dysphagia lusoria," or slow starvation, in diverticula of the œsophagus, carcinoma of the œsophagus, foreign bodies in the œsophagus, operations on the œsophagus, caries of the vertebræ (Potts' disease), scoliosis,[6] osteosarcoma of the vertebræ, heart disease (possible cause), small pulse on the right side, left-handedness ("causa anatomica"), operations on the thorax, ligations of arteries, and in bronchotomy in those rare instances in which the artery passes anterior to the trachea. The anomalous artery in its course fairly hugs the trachea and œsophagus, completely encircling them with an arterial band by crossing the right carotid artery just before passing over the first rib. This causes constriction of the trachea and œsophagus, with bulging of the two, on the one hand, and constriction of the right subclavian artery with dilatation of the latter, before it passes beyond the vertebræ, on the other. Gotthold Holzapfel[7] collected two hundred cases of this anomaly, including four of his own, and found dilatation of the artery in sixty-four per cent of the cases. Six of the cases had a funnel-shaped dilatation, and six showed a blind sac or pouch at the beginning of the artery, evidently aneurism. In the two cases found in the course of my work one was dilated, and in six other cases found in the literature besides the two hundred cases referred to above, one was reported to be dilated, no mention of dilatation being made in the other cases. Quain found this anomaly present four times in one thousand cases. Holzapfel considers it to be present six times in every thousand, while Tiedemann believed it occurred eight times per thousand. Holzapfel gives the following among many conclusions:

The anomaly is one of origin, of direction and of distribution; it arises about the second to fourth vertebra, also from the thoracic aorta lower down occasionally, and passes between the œsophagus and vertebral column (one hundred and seven

[3] Second Report of the Collective Investigation of the Anatomical Society of Great Britain and Ireland. Journal of Anatomy and Physiology, Vol. 26.

[4] Commentaries on the arteries, London, 1844.

[5] Virchow's Archiv., Vol. 54.

[6] Brent: The Lancet, 1844.

[7] Anatomische Hefte, 1897.

times), seldom between the œsophagus and trachea (twenty times), and rarely in front of the trachea (six times); was found sixteen times in persons beyond the age of fifty years; occurs in normal and abnormal individuals (anatomically); the right recurrent laryngeal nerve goes directly to the trachea, without its normal loop; the thoracic duct is transposed to the right side at times; the pneumogastric and phrenic nerves are not influenced, and the large veins have their normal distribution; the anomaly does not cause left-handedness, and dysphagia comes only with aneurism. Three cases of "dysphagia lusoria" have been reported in connection with this anomaly: One by Bayford[8] in which a patient sixty-one years of age, who had been suffering with difficult deglutition throughout life, died from inability to swallow. Another by Autenrieth and Pfleiderer,[9] in which a woman about sixty years of age died of slow starvation. A third by Brewer[10] of simple dysphagia. All of these cases were associated with aneurism of the anomalous right subclavian artery at its origin. A case of erosion of the vertebræ and aorta was reported by Picard,[11] in which the aorta passed between the œsophagus and vertebræ. A case of sudden death from swallowing a large mouthful, resulting in rupture of this anomalous artery is reported by Kirby.[12]

Three cases of heart disease associated with the anomaly have been reported, one by Walter,[13] in 1785; another by Froudsen,[14] in 1854, and a third by Schön,[15] in 1823.

Two cases of the anomaly in left-handed individuals were reported by Oehl.[16] Four cases have been reported in right-handed individuals.

Conclusions.

1. The subclavian artery may be arranged into five definite types according to the difference in origin of the large branches.

2. The artery differs on the two sides of the body, Type I being normal for the right side, and Type II for the left side.

3. Type I, without the thyroid axis as given in the anatomies of Quain and Gray, is the normal arrangement.

4. Type II, with the Thyroid axis is found fewer times than Type I.

5. Eighty per cent of the dissections were made in negro subjects, a large number of whom may have been mulattoes or mixed bloods. That hybrids tend toward variation is a well-known biological law. This may explain the large number of abnormalities encountered.

6. Four of the abnormalities are worthy of note: The lateral thoracic artery, Type V. The middle thyroid artery ("thryroidea ima"). The anomalous right subclavian artery.

7. These abnormalities may be of some clinical significance.

[8] Memoirs of the Medical Society of London, 1789, Vol. II.
[9] Reil's Archiv für die Physiologie, 1807.
[10] Journal de Chirurgie de Desault, Paris, 1791.
[11] Bulletin de la Societie Anatomique de Paris, 1840.
[12] Dublin Hospital Reports, 1818, Vol. II.
[13] Nouveaux Mémoirs de l'académie royale des sciences et belles lettres, 1785.
[14] Thesis: Arteriæ subclaviæ dextræ originis abnormis acdecursus Casus, Kiel, 1854.
[15] Thesis: Dissertation de nonnularum arteriarum ortu et decursu abnormi, Halle.
[16] Hyrtl's Topographische Anatomie, Zweite Band, 1882.

THE BLOOD IN PREGNANCY.

By William Lawton Thompson, M. D.,

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From the time of Morgagni the constitution of the blood during pregnancy has been a subject of interest to many investigators and has given rise to a great deal of discussion, which unfortunately has not led to uniform conclusions, even in the hands of those working with modern methods.

Leaving out of consideration the old theories as to plethoric and chloranæmic conditions of the blood, the more recent work upon the subject may be roughly classified in three groups:

1. An undoubted diminution in the amount of hæmoglobin and the number of red cells (Couvert, Wicolks, Wiskeman, Fouassier, Kosina and Ekert, Ingerslev, Meyer, Dubner).

2. A diminution in the number of red corpuscles with a simultaneous increase in the amount of hæmoglobin (Cohnstein and Fehling).

3. No change (Korniloff, Ehrlich and Limbeck); while Reinl, Lebedeff and Schroeder hold that the constitution of the blood depends upon the general health of the individual, being poor in red cells and hæmoglobin where the patient is feeble, while it is unchanged in normal individuals.

With regard to the leucocytes. Since Moleschatt and Nasse, the fact that pregnancy leads to leucocytosis has been constantly observed and confirmed. (Paterson, Maurel, Isambert, Spiegelberg, Fouassier and Mallasez, Halla, Kosina, Ekert, Mochnatscheff, Limbeck, Rieder and others.) This was referred by some to a hypertrophy of the groups of lymphatic glands lying in the neighborhood of the genital apparatus, while others (Wyder, Leopold, Johnstone) referred it to the lymphoid tissue of the endometrium. Mochnatscheff distinguished further differences between the blood drawn from the finger-tip and that taken from the cervix, and explains this difference by a process of irritation of the womb

whereby a leucocytosis takes place. He concludes that this undoubtedly causes the remarkable increase of colorless elements preceding delivery.

Rieder, who performed the largest series of observations, and who examined the condition of pregnant women after a fourteen to sixteen hours' fast, was able in only a small number of multiparæ to note a lack of increase in leucocytes; 21 out of 31 showing unmistakable leucocytosis. He is the only one of the observers who has studied in two cases the differential forms of leucocytes, as distinguished by Ehrlich, and whose figures agree with one another. He reckoned the average leucocytosis as 13,000, with a maximum figure of 16,500 and a minimum of 10,200. Others, as Mochnatscheff, place the maximum at 14,000.

Hahl concludes that during the last days of pregnancy the leucocytes are somewhat increased, that with the onset of labor pains a comparatively marked leucocytosis begins; this hyperleucocytosis (which is characterized by an increase of polymorphonuclear neutrophiles) is markedly diminished during labor, and usually during the first week of the puerperium a return to normal takes place.

Hubbard and White found a polymorphonuclear leucocytosis in 80 per cent of their 55 cases. Their averages 24 hours before labor were for primiparæ 15,000, for multiparæ 11,700.

As to the theories of a leucocytosis in pregnancy, Virchow referred it to a widening of the uterine and abdominal lymphatic vessels and nodes, and the increase of metabolism in the uterus and its contents. Limbeck supposes it to be due to changes in the breasts, viz.: the round-cell infiltration which many such glands show as an indication of a very active cellular process. Ewing concludes that "considering the behaviour of leucocytes in general, it is hardly surprising that the active cellular processes in breasts, uterus, vascular system and fœtus and the associated increase of metabolism should, when instituted for the first time, find a sympathetic excitement in the blood-producing organs."

With reference to the specific gravity of the blood, Nasse concludes from his observations on the blood obtained by venesection from 67 pregnant women that the decrease in specific gravity is not marked. Lloyd Jones confirmed these results, while he found in children and pregnant women the lowest figures and demonstrated a rise of specific gravity during the act of labor. While Lebedeff admits a falling off of blood gravity in pregnancy, Blumreich could establish no reason for it. According to Jones and Hammerschlag, who had proved a quite constant relationship between the decrease of specific gravity and that of the hæmoglobin and the count of red blood corpuscles, it must be concluded that corresponding to the drop in specific gravity, a diminution in red blood cells also takes place during pregnancy.

Zangemeister, who carried on observations upon women in the last two months of pregnancy, noted a diminution in specific gravity which he attributed to a loss in certain salts of the blood.

Among the most recent works on the subject of the blood in pregnancy is to be mentioned that of v. Rosthorn, who quotes the results of Payer with the conclusion that the blood of pregnancy has a normal number of red blood corpuscles, normal hæmoglobin, moderate leucocytosis, somewhat lessened native alkalinity, and normal molecular concentration. Pray finds a diminution of 80,000 red cells, with an increase of hæmoglobin and a hyperleucocytosis.

Observations.

In view of the unsettled state of this question, and in an endeavor to clear away some of the doubtful points concerning the blood state of pregnancy, we began observations on the blood of pregnant women in the Obstetrical Department of Johns Hopkins Hospital under the auspices of Dr. J. Whitridge Williams, to whom we wish to express our thanks for extending to us the courtesies of his department and for his many helpful suggestions and lively interest in this work.

The series includes 12 cases (11 colored and 1 white patient). The women were all of the poorer class, but are living under practically the same hygienic and dietary conditions, suffering from no constitutional disease and having no special pathological affections.

The observations cover a period of seven months, from October, 1903, to May, 1904. Each patient was examined once a month from the time she was first seen until the present date. Two of the cases first came under observation at the second month of pregnancy; two at the third month; four at the fourth month; three at the fifth; while the remaining case was not seen until the sixth month.

Four of the cases have been followed throughout their pregnancy and subsequent delivery, while the other eight are still under observation.

The monthly blood examination of each case includes (1) enumeration of red blood corpuscles, (2) estimation of hæmoglobin percentage, (3) count of leucocytes, (4) differentiation of leucocytes, and (5) determination of specific gravity of the total blood content.

The series comprises 33 separate blood examinations, each examination including 5 parts, or a total of 165 various estimations, whose results are as follows:

(1.) Red Blood Corpuscles.

The blood drop was in each case taken from the lobe of the ear, the Thoma-Zeiss instrument was employed and the blood diluted 200 times with Toison's solution. Out of a total of 33 cases, the average count in the—

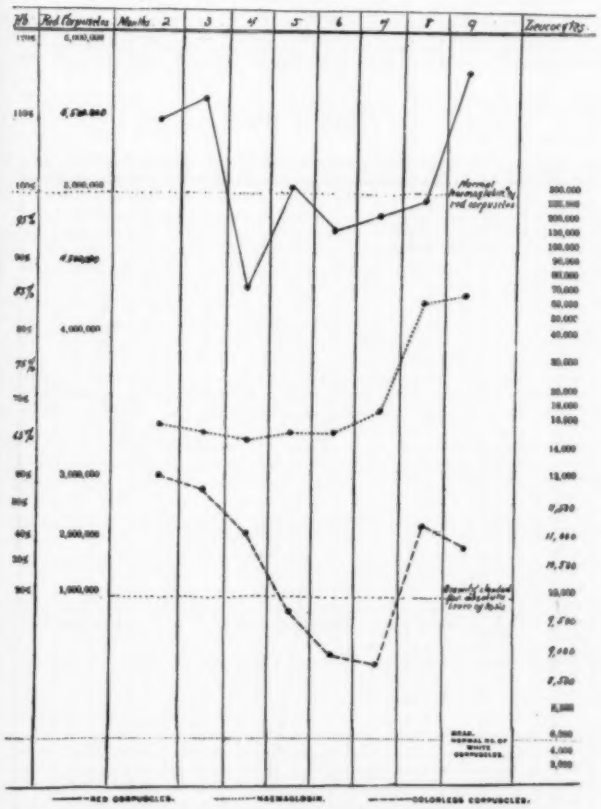
2nd	month	equalled	5,500,000	red	blood	cells.
3rd	"	"	5,600,000	"	"	"
4th	"	"	4,300,000	"	"	"
5th	"	"	5,000,000	"	"	"
6th	"	"	4,600,000	"	"	"
7th	"	"	4,700,000	"	"	"
8th	"	"	4,900,000	"	"	"
9th	"	"	5,800,000	"	"	"

The following table gives the figures in detail for each month from the 2nd to the 9th inclusive:

CASES.	2d mo.	3	4	5	6	7	8	9
No. 1	5,508,000	....	4,716,000	....	....	4,620,000	....	....
2	....	....	3,480,000	3,864,000	4,004,000	4,888,000	4 440.000	....
3	....	....	4,480,000	5,480,000	5,048,000	5,592,000	4,932,000	....
4	....	....	....	4,900,000	4,488,000	3,948,000	....	....
5	....	....	....	4,876,000	5,156,000	4,604,000	5,616,000	5,876,000
6	5,520,000	5,208,000	....	....	....	....	....	....
7	....	4,628,000	4,800,000	5,384,000	...	....	....	....
8	....	7,008,000	5,464,000	....	....	....	....	....
9	....	....	....	4,644.000	4,948,000	....	....	....
10	....	....	5,164,000	....	....	....	....	....
11	..	4,068,000	....	....	....	....	....	....
12	....	4,540,000	....	....	....	....	....	....
Averages :	5,514,000	5,614,666	4,347,333	5,018.857	4,680,000	4,700,666	4,996,000	5,876,000

It is clear that in our series the count is high at the extremes of pregnancy (5,500,000 at the second and third months and 5,800,000 at the ninth month) while it is somewhat lower in the intermediate periods—4th to 8th months inclusive—dropping to 4,300,000 at the 4th month, then rising irregularly to reach 5,800,000 at the ninth month. It will be seen from

CHART I.



the average curve (Chart I) that this drop after the beginning of pregnancy with a low intermediate value and an irregular rise as labor comes on, is quite well marked. By reference to the above table of figures it will be seen that cases No. 1, 4, 6 and 8 show the initial drop, while case No. 5 shows the terminal rise in red blood corpuscles.

(2.) HÆMOGLOBIN.

As in the case of the red cells, the drop was drawn from the ear and the computation made with Gowers' apparatus, which was standardized against a new Miescher instrument, the two instruments recording the same. The figures obtained (percentages) are shown in detail in the following table:

Cases.	2d mo.	3	4	5	6	7	8	9
No. 1.....	70	..	65	..	..	55	..	..
2.....	..	..	55	55	65	70	72	..
3.....	..	..	80	83	80	80	90	..
4.....	..	..	..	60	60	65	..	..
5.....	..	..	..	70	65	60	90	85
6.....	65	65	..	..	..	..	..	..
7.....	..	60	65	..	..	82	..	..
8.....	..	75	..	60	..	..	..	..
9.....	..	.	..	..	60	70	..	..
10.....	..	..	..	70	..	..	..	..
11.....	..	..	70	..	..	..	..	..
12.....	..	..	55	..	..	..	..	..
Averages:.....	67.5	66.7	65	66.3	66	68.8	84	85

The hæmoglobin, therefore, as early as the 2nd month of pregnancy is low, continues at this level (65 to 67 per cent) until the 7th month, when it begins to increase, until at the 8th and 9th months it has risen to 85 per cent—a gain of nearly 20 per cent.

(3.) LEUCOCYTES.

Cases.	2d mo.	3	4	5	6	7	8	9
No. 1.....	11,650	..	11,200	..	..	10,640	..	..
2.....	..	..	11,250	10,050	9,960	9,150	13,250	..
3.....	..	..	10,950	11,080	9,250	8,400	13,200	..
4...	..	..	..	8,550	5,480	7,600	..	..
5.....	..	..	..	8,950	10,000	7,666	7,050	10,750
6.....	12,600	12,700	..	..	..	..	..	..
7.....	..	11,000	11,100	..	..	9,100	..	..
8.....	..	..	..	8,132	..	..	..	..
9.....	..	..	..	..	9,500	..	..	..
10.....	..	..	..	11,400	..	..	..	..
11.....	..	..	11,500	..	..	..	..	..
12.....	..	..	10,200	..	..	..	..	..
Averages:.....	12,125	11,850	11,033	9,693	8,838	8,759	11,166	10,750

For determining the leucocytes, a blood drop was taken from the lobe of the ear, avoiding pressure, diluted 20 times with Toison's solution, and the leucocytes counted with the Thoma-Zeiss apparatus.

As is seen by the table, in only one of the 33 counts were the leucocytes below 7,000. The minimum was 5,400, the maximum 12,700, while the average was about 9,000.

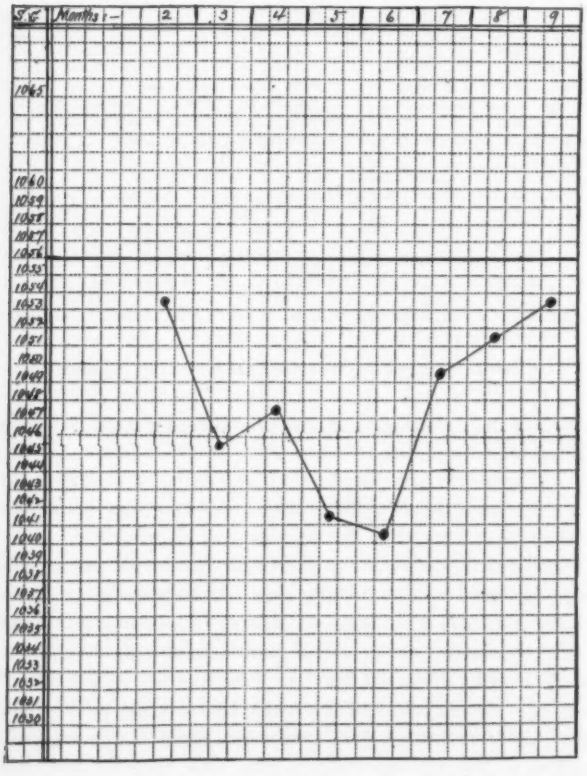
In only the one case did the leucocytes reach the normal mean standard of 5,500, while most of the cases had a leucocytosis of 10,000 to 12,000. A leucocytosis in any given case is always relative, not to a fixed standard, but to that individual in health. Now, if we take 5,500 as the mean normal number of leucocytes, it will be seen, by referring to the above table, that, not only do *all* our cases present a leucocytosis *relative* to the average woman, but, with Grawitz' standard of 10,000 as the criterion, the majority of them, in the different months of pregnancy, show a *slight absolute leucocytosis.*

(4.) Differential Count of Leucocytes.

Smears were prepared by allowing a small drop of blood to fall upon a cover slip which was brought in contact with another slip, the two being then drawn rapidly apart and the thin smear of blood dried in the air. They were then stained with Wright's modification of Leischmann's stain. Thirteen differential counts were then made, and in each instance 500 cells were studied, the results being given in the following table:

Cases.	Polymorphonuclear neutrophiles.	Small mononuclears	Large mononuclears	Eosinophiles.
No. 1.....	364	85	48	3
2.....	419	51	23	4
3.....	387	88	22	3
4.....	426	47	26	1
5.....	343	103	53	1
6.....	410	49	20	20
7.....	357	110	33	0
8.....	380	92	38	15
9.....	397	85	17	1
10.....	300	147	53	0
11.....	310	138	46	6
12.....	367	83	45	5
13.....	372	96	28	4
Averages.....	371	90	34	5
Percentages.....	74.2%	18%	6.8%	1%

CHART II.



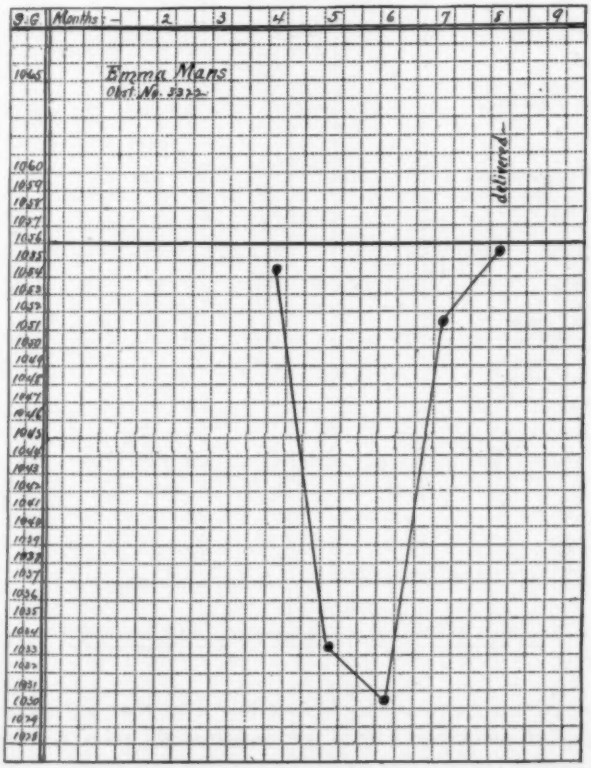
These results show an increase of 2 per cent in polynuclears and about the same in large mononuclears, while the small mononuclears are diminished about 5 per cent and the eosinophiles about 2 per cent from the accepted standard for these cells, but practically the differential count is normal.

(5.) Specific Gravity.

The specific gravity was determined in 33 estimations. The gravity of the total blood content (not of its serum) was obtained. We followed the method of Hammerschlag, using the benzol-chloroform mixture, and obtained the following figures for the several months:

Cases.	2d mo.	3	4	5	6	7	8	9
No. 1	1057	..	1043	..	..	1047	..	..
2.....	..	..	1054	1033	1030	1051	1055	..
3.....	..	..	1057	1049	1042	1047	1050	..
4.....	..	..	..	1048	1043	1046	..	..
5.....	..	..	..	1042	1039	1042	1050	1053
6.....	1050	1051	..	..	..	..	..	..
7.....	..	1032	1035	..	..	1052	..	..
8.....	..	1052	..	1045	..	..	..	..
9.....	..	..	..	..	1050	1058	..	..
10.....	..	..	..	1032	..	..	..	..
11.....	..	..	1050	..	..	..	..	..
12.....	..	..	1046	..	..	..	..	..
Averages:.....	1053.5	1045	1047.5	1041.5	1040.8	1049	1051.6	1053

CHART III.



As will be seen from the above figures, the specific gravity is, as a rule, high in the early months of pregnancy, diminishes progressively in the ensuing months, to again rise to nearly

normal at the termination of the gravid state. In some cases the specific gravity decreases intermittently; in others (Chart III, Case No. 3322) the decrease is regular, while in all cases the gravity is subnormal. The initial fall and terminal rise can be traced in every case.

If we take the average specific gravity of all the cases for each month, and plot a curve (Chart II), or if each case be examined by itself, the curve will be found the same in either instance—high at the beginning and end of pregnancy, low in the intermediate months.

Nasse, in 1853, pointed out that the blood gravity decreases rather early in pregnancy and rises somewhat at its termination, but he did not demonstrate any regularity in this respect, indeed he stated that the decrease is not marked.

Jones and Hammerschlag conclude that corresponding to the drop in specific gravity, a diminution in red blood cells also takes place during pregnancy. This corresponds with the results of our observations, as will be seen by referring to Chart I, where the curve of red blood corpuscles is shown.

Water enters so largely into the composition of the blood, and as it is, moreover, the most variable constituent, we should expect alterations of the blood gravity under ordinary conditions to be due largely to this factor.

The proportion of salts, on the other hand, is small, less variable, and hence less likely to effect any marked alteration in the specific gravity. Zangemeister, however, refers the low specific gravity to a loss of certain salts.

The albumens of the blood are the last principle to be affected by alterations of metabolism, and, as Ewing remarks, "when the albumens of the blood are affected, marked and permanent changes result in its specific gravity."

That marked and permanent changes do occur in the specific gravity of the blood and that corresponding to this drop a decrease in red blood cells also takes place in pregnancy has been repeatedly demonstrated in our observations. It is possible that the reduction in specific gravity during pregnancy may be due to a decrease in the albuminous elements of the red blood cells.

Dieballa showed that a diminution of 10 per cent hæmoglobin corresponds to a drop of 4.46 p. m. specific gravity. Now, if the drop in hæmoglobin was proportional to the fall in specific gravity, we might attribute the latter to the former, since, as is well known, the determination of specific gravity is a well-recognized method of determining the hæmoglobin.

Our results, however, tend to show that the hæmoglobin is proportionately higher than the specific gravity of the total blood content (as in Case 3322 shown in Chart III), the drop in hæmoglobin being only 20, while the drop in specific gravity was 24. It is evident, therefore, that the drop in specific gravity is not due to the drop in hæmoglobin.

Slemons, in a recent contribution, has shown that the organism, under the influence of pregnancy, stores much more water than at other times, and, moreover, that, preceding labor, a marked diuresis occurs.

In view of Slemons' findings, we are inclined to believe that the low specific gravity of the blood in pregnancy is due to an admixture of water in the plasma—a serous dilution or hydræmia, and that the terminal rise in specific gravity as labor approaches may possibly be due to the marked diuresis which occurs at that time.

CONCLUSIONS.

1. A moderate decrease is observed in red blood corpuscles rather early in pregnancy, remaining subnormal throughout the middle months, to rise again to normal at the termination of pregnancy—not, however, in all cases.

2. A low percentage of hæmoglobin, constant throughout the first seven months, rapidly approaching normal as pregnancy draws to a close.

3. A slight absolute leucocytosis exists in every case of pregnancy, but this slight leucocytosis does not support the theory that it is due to any positive chemio-taxis.

4. There is no variation from normal in the different forms of colorless corpuscles, the leucocytosis affecting all forms of white cells alike.

5. The specific gravity is high at the onset of pregnancy, diminishing by progressive steps, to reach its lowest level in the middle months, rising to normal at term.

A CASE OF GENERALIZED LEAD PARALYSIS, WITH A REVIEW OF THE CASES OF LEAD PALSY SEEN IN THE HOSPITAL.

BY HENRY M. THOMAS, M. D.,

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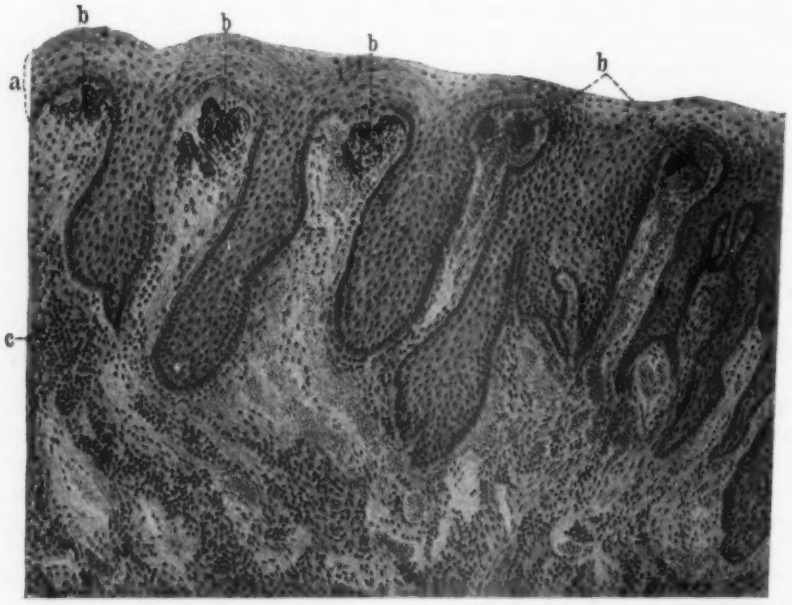
This patient, from Dr. Osler's ward, has interested us very much, because his condition is one of great rarity and because we have seen no exactly similar case. The patient was admitted Nov. 3, 1903. He is a man of 46, and has been at work as an enameller. The process employed in the factory in which he worked is a secret one, but it is quite certain that the material used contains a great deal of lead. There is nothing else of importance in either his family or personal history, except in relation to his use of alcohol. He has been a heavy drinker, taking several glasses of beer a day, as well as more or less whiskey, and on Saturday nights, when he had the money, he was in the habit of drinking much more, usually going to bed drunk.

He had formerly worked as a stevedore, but last summer became an enamel worker. After working at this new occupation for only two weeks, he noticed that he was becoming weak. This weakness showed itself first in his legs, but it increased and spread so rapidly over his body that in a little

more than a week he had become bed-ridden and helpless. He gives no history of having had any pain in his stomach or sharp pain in his legs or arms, but certain of the joints have been painful. His mother told us that soon after he took to his bed he was for several days somewhat delirious. The patient was admitted to the hospital about two months after he had become paralyzed. Since then he has shown no sign of mental disturbance.

As you see, the patient is a pale, sick-looking man. His blood count gives red blood corpuscles 3,736,000, white blood corpuscles 3,100, hæmoglobin 40 per cent. After repeated examinations, granular degeneration of the red blood cells was demonstrated. There is a typical lead line on his gums, and under the microscope Dr. Stevens has placed a section of a bit of the gum which shows very well that the black



sulphide of lead is deposited in the substance of the tissue itself (see illustration).

There is no involvement of any of the cranial nerves and an ophthalmoscopic examination showed the fundus to be normal. The muscles of his neck are fairly strong but below these nearly every muscle is completely paralyzed. There is slight power in the pectoral muscle, but nowhere else in the shoulder-girdle or arms. You will notice that his respiration is entirely thoracic, the diaphragm being completely inactive. The muscles of the trunk are also affected and in the legs the only motions that are left are slight flexion at the hip and feeble movements of the toes. The reaction of degeneration to the electrical currents is present in the paralyzed muscles. The deep reflexes are all lost. Sensation is everywhere acute. Firm pressure over the various muscle groups in the arms and legs causes pain. The right shoulder joint is somewhat swollen and painful. There is no disturbance in either the bladder or rectum.

The picture which he presents is a very typical one of a severe multiple neuritis, but the interesting point is that this is apparently due to an intense intoxication by lead. The trouble came on a man (who, to be sure, has a strong alcoholic history) two weeks after he began to work in lead, and who now shows the evidence of lead poisoning, the lead line and a granular degeneration of the red blood corpuscles. The paralysis has not the distribution that is typical of lead, but similar cases have been described by several authors under the title of "Generalized Lead Paralysis."

NOTE.—April 15, 1904. The patient has improved slowly and has recovered a considerable amount of power in the muscles about the shoulder-girdle and the hip-joint. His anæmia has decreased. There is considerable atrophy of the muscles.

I have examined the records of the hospital and the neurological dispensary and have found that 33 cases of lead poisoning have been admitted to the medical wards and 25 have been treated in the nervous dispensary. Four of these 58 cases were seen in both departments and we have therefore the histories of 54 patients. As would be expected, the cases entering the hospital are of very different character from those seen in the out-patient department. In the neurological dispensary we meet only with cases showing definite nervous symptoms, and see none of the cases suffering from the more common effects of lead poisoning, constipation, colic, etc., these cases being referred to the medical dispensary. The patients admitted to the wards are usually those who show the more intense form of gastro-intestinal disturbances, or have evidence of grave intoxication. Of the 33 hospital cases, there was no complaint of muscular weakness in 23; in 6 of these, however, some slight muscular involvement was discovered on examination, and in one case, complicated with

heart disease, a hemiplegia developed while in the hospital. In 10 cases there was definite motor paralysis.

Of these 10 hospital cases showing paralysis, 5 exhibited the usual form of lead paralysis, viz.: double wrist-drop. In one case the wrist-drop was confined to the right side; in the four remaining cases both the arms and legs were more or less severely affected.

Of the 25 cases treated in the neurological dispensary, 23 of them complained of paralysis. Fifteen of these showed bilateral wrist-drop, 6 paralysis confined to the right arm, and in one it was confined to the left arm. In one case the paralysis was confined to the leg, in the distribution of the right external popliteal nerve; this last, however, is a doubtful case, as the paralysis developed in a painter after a long day's work in a squatting position, and the nerve may have been injured by pressure.

If we combine the records of the hospital and dispensary cases, deducting the duplicate cases, we have 31 cases of lead paralysis. Eighteen of these showed the typical distribution of paralysis in the form of double wrist-drop. In 7 the weakness was confined to the right arm and in one to the left, *i. e.*, the paralysis was confined to the arms in 26 cases. The arms and legs were involved together in 4 cases. The remaining case, in which the right leg alone was affected, I think should be excluded.

We are particularly interested to-night in these four cases in which the paralysis affected the legs as well as the arms.

CASE I (No. 2293) was that of a girl, five and a half years old, who was in the habit of eating the remains of food left in tin cans, and who had had weakness of her arms for three months. Two days before admission her legs became so weak that she was entirely unable to walk. There was a lead line on the gums; knee jerks were normal. She remained in the wards only two days. It is worthy of note that this is the only case of suspected lead poisoning that we have had in a child, and it agrees with the statement of some authors that in children the legs are particularly apt to be affected.

CASE II (No. 2617), a tinner, 42 years old, was admitted on account of paralysis of his legs, which had come on suddenly eight days before. There was marked weakness of his legs and to a less extent of his arms. Deep reflexes were absent. No lead line was discovered, and there seems to have been loss of control of his rectum, which facts throw doubt upon the diagnosis.

CASE III (No. 11,733) was a painter, 43 years old, with a history of many attacks of colic and weakness of his arms for several years. He was admitted on account of pains in his arms and legs. There was definite, although not great, loss of power in the muscles of his legs, as well as in his arms. His knee jerks were exaggerated; there was a distinct lead line.

CASE IV (No. 13,757) is of particular interest, as it shows an intense degree of intoxication. The patient was a man, 28 years old, an enameller by trade, as is the patient now before you, and had worked in lead for eight years. He came to the neurological dispensary with the history that two months before he had had an attack of unconsciousness and that six weeks after this had begun to suffer from headache and weakness of wrists. He then developed pain in his knees. He kept on working for a week, his wrists becoming weaker and his legs becoming numb and weak. He then had severe colicky pains in his stomach and began to vomit. This persisting, he entered the hospital on the second day. He was evidently very weak and ill and was at once sent to the wards. There was a general weakness of arms and legs with well-marked wrist- and ankle-drop. Deep reflexes were not obtained in arms and were present but not exaggerated in legs. Sensation was normal. The lead line was present. There was no change in the fundus oculi. On the evening of the day of his admission to the hospital he became delirious, imagining spirits were after him. The next morning he was perfectly rational but again became delirious in the evening of the fourth day, and was more or less unconscious from that time on. On this day he developed fever and in a day or two meningitis was suspected. Lumbar puncture did not confirm this and it was soon evident that he had pneumonia. He died 19 days after entering the hospital. The blood was examined on two occasions but no granular degeneration of the red blood cells was found. Broncho-pneumonia and chronic tuberculosis were found at autopsy.

Of these four cases, the second should not have been included, since, other than his occupation, there is nothing that speaks for lead as being the cause of his paralysis; and we therefore have, with the case you have just seen, four patients in whom the legs were more or less affected. The paralysis in the other three had not this widespread distribution and this is the only case that deserves to be classed as *acute generalized lead paralysis*. Similar cases have been described by Mme. Dejerine-Klumpke, E. Remak and others. The involvement of the diaphragm, which is so beautifully shown in this patient, makes the case a serious one and we dread for him an extension of the paralysis to the intercostal muscles or any intercurrent respiratory infection, as we fear he would be unable to withstand a further interference with his respiration.

You may have noticed that the enameller who died in the hospital showed marked mental symptoms before the development of his terminal pneumonia. He was delirious and difficult to control on two different nights, but quite rational on the following mornings. The patient before you to-night is said to have been delirious at the onset of his trouble. Three of the other hospital patients also showed marked cerebral involvement. Thus, a patient (No. 5608) was admitted with tremor of hands and subjective feelings of weakness of arms and legs. There was a lead line on the gums. He gives the history of having been subject to attacks of vertigo and of having had two attacks of unconsciousness While under treatment he developed delusions of persecution with maniacal excitement and had to be removed to the insane wards at Bay View. In this case there was also a history of alcohol and syphilis. Still more interesting was the case of a carriage painter (No. 13,677), who came in suf-

fering from a severe attack of lead colic. He had had five previous attacks. There was no paralysis but a definite lead line was present and the red blood cells showed the typical granular degeneration. On the second day of his stay in the hospital he became delirious and then unconscious for a short time. Upon regaining consciousness he seemed rational, but complained that he was completely blind. No changes could be seen in his eye-grounds and he regained his sight in half an hour. Two days after this he had another attack of unconsciousness but without visual disturbances. His recovery was rapid and he soon left the hospital. He was readmitted the next year with another attack of colic, with which, however, there were no cerebral symptoms.

Another painter (No. 14,101), with colic and double wrist-drop, who showed a marked lead line and granular degeneration in the blood, was more than once delirious during the night, while in the wards.

Among the dispensary histories of patients who were not admitted to the hospital I find the mention of cerebral symptoms twice. In one case it was delirium during the night in a stereotyper with double wrist-drop, and in another it was an attack of unconsciousness and convulsions in a lad of 18, who had gotten his poisoning while working as a brass finisher.

These patients illustrate the fact that lead at times exerts its poisonous effects on the brain. This has been well recognized ever since Tanquerel's fundamental monograph in 1838. He classes such cases under the term "Lead encephalopathy."

The experience in this hospital in regard to the source from which the poisoning was derived differs very little from that of others. More than half of the patients (28) worked with paints containing lead. The other group is made up of workers in various other trades in which lead is more or less used (brass workers, 4; enamellers, 3; can-makers, 3; tinners, 2; stereotypers, 1; glass-cutters (putty), 1 etc.), and of those who had taken the poison as medicine or in food. Four patients had slight lead poisoning after taking lead and opium medicinally for a considerable time; one was severely affected from drinking home-made wine, which had been kept in a cask fitted with a lead pipe, and the little girl who was so severely paralyzed got the lead, we thought, by eating the scrapings of food which remained in cans. In four cases we were unable to determine any probable source for the lead.

NOTES ON NEW BOOKS.

The Self-Cure of Consumption without Medicine. By CHAS. H. STANLEY DAVIS, M. D., Ph. D. (*New York: E. B. Treat & Co., 1904.*)

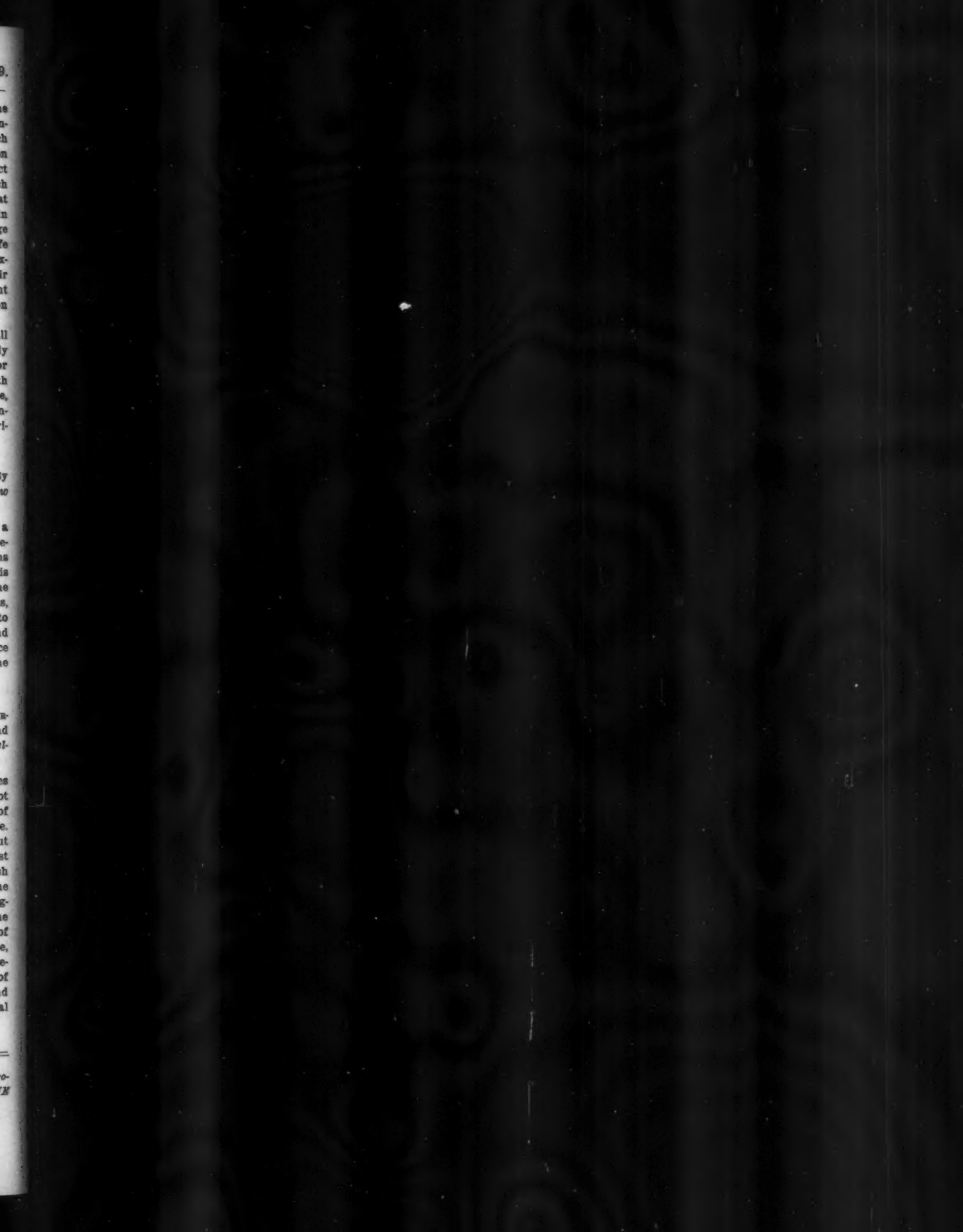
The central idea of this little book, namely, that the cure of consumption is largely in the hands of the patient himself, is one of great importance, since the cure of tuberculosis is, as the writer remarks, "the most important economic problem that confronts the American people." Its relief, in his opinion, is much less dependent on climatic surroundings than has hitherto been supposed; they are, indeed, but one factor, and can never act beneficially in the absence of hygenic conditions. To secure such conditions, especially in respect to food and exercise, is the great object towards which effort should be directed, and residence in a sanatorium is essential to its accomplishment in a large number of cases. For, although the necessary regulation of life is largely within the patient's own hands, it is only the exceptional patient who can be trusted to carry them out in their integrity. The description of the methods employed in different sanatoria are interesting, and afford much useful information for those who require it.

The chapter devoted to showing the uselessness of almost all drugs in the treatment of consumption is prudently and carefully written. As a whole, the book contains all that is essential for the information of the public mind on the subject, put with clearness and common sense, and it is, therefore, a work of value, for the education of the public is the one means by which consumption can ever be eradicated, and everything which contributes to this end deserves respect and consideration.

The Blues (Splanchnic Neurasthenia); Causes and Cure. By ALBERT ABRAMS, A. M., M. D., Heidelberg, F. R. M. S. (*New York: E. B. Treat & Co., 1904.*)

The object of this little book is to focus attention upon a special form of nervous exhaustion, characterized by extreme depression, which arises from congestion of the abdominal veins affecting in turn the splanchnic nerves. The writer presents his theory with much elaboration, but the clinical evidence which he brings to support it is inadequate for the purpose. Nevertheless, there can be no doubt that too little attention is paid as yet to the influence of the splanchnic nerves in the human economy and the book deserves attention from a suggestive point of view, since it is more than possible that further investigation along the lines which it follows, will repay effort.

Manual of Clinical Microscopy and Chemistry. By DR. HERMANN LENHARTZ; authorized translation from the fourth and last German edition by HENRY T. BROOKS, M. D. (*Philadelphia: F. A. Davis Company, 1904.*)

In the preface to the first edition of his book the author states that it has been his endeavor to present a work which shall not only instruct in chemical microscopy and chemical methods of examination, but aid in interpreting their diagnostic significance. He is to be congratulated on his success in both respects, but particularly in the second. Practical utility is the book's most striking characteristic, and English speaking, or rather English reading people are fortunate in having access to it through the medium of a good translator. The author has shown good judgment in devoting special attention to the chemical side of the book, for the constantly increasing importance of this side of clinical diagnosis makes its development especially valuable, and in this connection the section on examination of urine deserves particular notice. The book contains a large number of excellent illustrations, and its value is enhanced by a full and accurate index, which in any manual is indispensable to real service.

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